Economic Assessment of the Revised LDR Treatment Standards for Spent Aluminum Potliner (K088)

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1.0 EXECUTIVE SUMMARY

This economic analysis estimates the impacts of the establishment of a treatment standard for fluoride in nonwastewaters and a revised treatment standard for cyanide in nonwastewaters from spent aluminum potliners (SPL, EPA hazardous waste code K088) under EPA's Land Disposal Restrictions (LDR) program. If promulgated, nonwastewater forms of K088 waste would have to meet a new treatment standard of 2.7 mg/L fluoride, when measured by a variant of the Toxicity Characteristic Leaching Procedure which uses deionized water as the leaching fluid. In addition, the Agency is proposing to revise the treatment standards for total and amenable cyanide in K088 nonwastewaters from 590 mg/kg and 30 mg/kg to 1.4 mg/kg and 1.4 mg/kg, respectively.

1.1 Methodology

In order to estimate the incremental costs associated with the establishment of a fluoride treatment standard and a revised cyanide treatment standard, this analysis estimates the predicted impacts on the primary aluminum smelters which reported generation of K088 in the 1997 Biennial Reporting System (BRS). Economic impacts were estimated based upon a percent of sales for three different scenarios:

Scenario 1 Assumes two facilities will be available for treating K088, one owned by Reynolds Aluminum, Gum Springs, Arkansas, and one storage facility owned by Chemical Waste Management in Oregon. Both facilities are assumed to be retrofitted (Reynolds using the Vortec technology and Chemical Waste Management using the Goldendale process) to meet the revised treatment standards;

Scenario 2 Assumes only the treatment facility owned by Reynolds Aluminum, Gum Springs, Arkansas will be available. This facility is assumed to be retrofitted using the Vortec technology; and

Scenario 3 Assumes that facilities in the Pacific Northwest treat on site using either Vortec or Goldendale (using a cost structure similar to the Ormet facility in Hannibal, Ohio), and assumes that the Reynolds facility will be retrofitted using the Vortec technology.

To establish the baseline management unit costs for the economic impact analysis, transportation costs were determined for each aluminum smelter. Unit costs were consistent with the 1998 Interim Final K088 treatment standards ruling. Economic impacts were estimated as a percent of sales; sales values for each of the smelters were estimated. Aluminum production in 1997 was almost 4.0 million tons, while production capacity for the smelters reporting generation of K088 was estimated at almost 4.5 million tons, implying a capacity utilization of approximately 88

percent. To estimate production, each facility was assumed to be operating at 88 percent of capacity, and sales were estimated using the average aluminum price reported in 1997.

1.2 Number of Affected Facilities

In assessing the economic impacts of establishing a treatment standard for fluoride and revising the treatment standard for cyanide in spent aluminum potliner, the Agency conducted an inventory of the active aluminum smelters in the U.S. that currently generate K088 based upon the 1997 Biennial Reporting System (BRS). Based on the BRS data, 22 active aluminum smelters have been identified as currently generating K088. The new treatment standards are expected to increase the K088 management costs at 21 of these 22 facilities. In 1994 unit treatment charges for K088 by Reynolds Metal were estimated by company officials to be between $200 per ton and $500 per ton including ash disposal.[1] The Agency confirmed that these treatment and disposal prices are still current.[2] One facility, Ormet Primary Aluminum Corporation, Hannibal, Ohio, has installed the Vortec vitrification technology which has been proven to treat to the new standards.

1.3 K088 Generation Quantities and Management Practices

Generation quantities for the 22 active aluminum smelters were obtained from the 1997 BRS (except for Kaiser Aluminum & Chemical Corp., Mead, Washington, where 1995 BRS data were used.). Approximately 41 percent of the aluminum smelters accounting for 43 percent of the total K088 generation are located in the Western U.S. The largest K088 generator is located in Washington (Intalco Aluminum) which reported generating 8,681 tons (nearly 10% of total generation) in 1997. A total of 87,746 tons of K088 waste were reported managed in 1997 (including the 1995 reported quantity for Kaiser Aluminum & Chemical Corp., Mead, Washington.) The current K088 treatment standards became effective in October 1997. As the result, several of the reported management practices (including off-site incineration, on-/off-site landfill, and off-site stabilization) did not meet the October 1997 standards. This created a shift in management practices at the end of 1997 to the Reynolds' thermal treatment plant in Gum Springs, Arkansas, and Chemical Waste Management's on-site storage facility in Oporlliam, Oregon.

1.4 Compliance Costs

The Vortec technology is the only proven technology that can meet the new treatment standards under the proposed rule. EPA believes that vitrification and incineration vendors can set up their process to receive and treat K088 if they buy crushers and mills to reduce the size of the K088 blocks of waste (e.g., potentially up to 3 feet in length), enabling it to be fed into their

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[1] Based on conversation with Jack Gates, Vice President, Reynolds Metals Company, September 28, 1994 as reported the Phase III RIA p. 3-16.

[2] Personal Communication with Pat Grover, Reynolds Metal Company, and Linda Martin, U.S.E.P.A., August 6, 1999.

technologies. As the result, crusher and hammer mill unit costs were developed by scaling vendor cost estimates. Estimates were based upon a 7 percent discount rate, 10-year equipment life, 20-year plant life, and a 30 percent profit margin. One 36 ton per day plant has been constructed in Paducah, Kentucky in 1996 for the Department of Energy at a cost of $11.6 million. Assuming that operating costs of between $150 and $300/ ton are similar to the non-hazardous waste vitrification system, the unit commercial price would range from $330/ton and $550/ton (excluding crushing and milling equipment).

Published commercial prices for vitrification ($300/ton) and incineration ($650/ton) were used as potential price ceilings for the Vortec technology in the market when new capacity is constructed. Estimates of commercial crushing ($25/ton to $47/ton) and milling ($41/ton to $79/ton) prices are added to the vitrification and incineration prices to determine the total compliance management unit cost. Assuming two crushing units, one hammer mill, and a vitrification unit, commercial prices range from $391/ton to $473/ton. Similarly, using two crushing units, one hammer mill, and an incineration unit, commercial prices range from $741/ton to $823/ton.

For all three management scenarios, annual cost impacts were estimated to range from approximately 0.2 to 0.7 percent of sales, or $15 to $41 million in aggregate cost for all facilities. It is important to note that impacts on some facilities were substantially higher, ranging to above 1.8 percent of sales. These high impacts are likely due to the periodic nature of the waste generation by individual companies.

In addition, the aluminum smelters in the Northwest which have been storing their wastes (estimated based on a range of 20,000 to 143,000 tons) are expected to incur costs associated with the treatment of K088. Disposal options for the stored K088 are considered under the three management scenarios. Cost estimates under the three scenarios range from $36 to $119 million.

Overall, the proposed revision in the K088 LDR treatment standard is not expected to have a significant impact on a substantial number of small primary aluminum producers. It is a Category 1 rule, and presumed not to have a significant impact on a substantial number of small entities. In 1997, U.S. primary aluminum producers sold 4.0 million tons of aluminum at an average market price of $1,542 per ton yielding total sales of $6.1 billion. The $40 million upper bound cost estimate represents only 0.7 percent of the total value of the aluminum sold by primary aluminum producers. As additional treatment capacity and recycling alternatives become more available, annual costs for K088 management to primary aluminum producers should decrease.

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2.0 INTRODUCTION

2.1 Background

The U.S. Environmental Protection Agency (EPA) promulgated a final rule for spent aluminum potliner, a listed hazardous waste (hazardous waste designation K088) that provided a revised treatment standard for arsenic prior to land disposal. The revised treatment standard for arsenic expressed the standard in terms of total concentration (totals) rather than an extract using the Toxicity Characteristic Leaching Procedure (Method 1311). EPA had previously promulgated a treatment standard for spent aluminum potliner/K088 in the Phase III Land Disposal Restriction Final Rule. 61 FR 15566 (April 8, 1996). As part of that rulemaking, EPA completed a draft Groundwater Pathway Analysis and Regulatory Impact Analysis assessing the potential risk reduced and cost of promulgating the K088 treatment standard. The Groundwater Pathway Analysis indicated that cyanide would not be a problem for untreated potliner in Subtitle C landfills. The Regulatory Impact Analysis indicated that the cost of treatment attributable for the final Phase III rule for spent aluminum potliner was between $6 million and $42 million.

In April of 1998, the United States Court of Appeals for the District of Columbia vacated the treatment standard and prohibition for spent aluminum potliner/K088 although its holding was limited to arsenic and fluoride as the only constituents having a TCLP standard that under predicted their mobility. Columbia Falls Aluminum Co. vs. EPA 139 F.3d 914 (April 3, 1998). The Court invited and granted EPA's motion to delay the effect of its ruling until completion of an interim final treatment standard to rectify the standards for fluoride and arsenic.

On September 24, 1998, the Agency promulgated interim treatment standards for spent potliners from primary aluminum reduction (K088). In this rule, the Agency committed to establishing final treatment standards within the next two years. In response to this commitment, the Agency is proposing to establish a treatment standard for fluoride in spent aluminum potliners and revising the treatment standard for cyanide in K088. The Agency has reviewed treatment technologies for thermal destruction of K088 waste and gathered new treatment data to develop treatment standards for cyanide and fluoride. In particular, the Agency has assessed the effectiveness of vitrification on K088 waste. Vitrification treatment enables K088 to be treated while generating a product from the vitrified K088.

2.2 Limitations of Analysis

This analysis does not capture all of the variables that may affect the impacts of the proposed rulemaking. Limitations include assumptions regarding waste management costs, facility revenues and qualitative benefits. Some of these limitations include:

- No commercial capacity currently exists for the Vortec process; therefore, pricing of the Vortec process within the market are estimated based on the commercial price of substitute technologies (i.e., vitrification and incineration).

- Where future commercial capacity for the Vortec process will be constructed is unknown. Scenarios in this analysis assume that the Vortec technology will be constructed in Arkansas and Oregon where commercial K088 treatment and storage facilities currently exist using non-Vortec technologies.

- This analysis was completed with a lack of information regarding the charges for the licensing of the Vortec process. Licensing charges were estimated based on general information regarding licensing such intellectual property, and may not be reflective of any fees levied.

- Available capital cost information for the Vortec process is limited to one 36 ton per day DOE facility constructed in Paducah, Kentucky to treat contaminated soil.

- Operating costs for the Vortec process were not available for the Paducah, Kentucky plant. They were estimated based on information available for commercial vitrification technologies, a similar technology.

- Capital and operating cost information were not available for the Goldendale process. Costs were estimated for the Goldendale process assuming they would be similar to the Vortec process.

- Cost estimates for the Vortec process do not account for potential future revenue streams from the glass frit and recovered fluoride by-products. Or, if markets are not available for these by-products, the cost estimates do not account for potential future treatment and/or disposal costs for the glass frit and recovered fluoride by-products.

- The production levels for each of the aluminum smelters were estimated assuming that their production corresponded to overall industry capacity utilization rates.

- The benefits estimation did not quantify the total reductions in exposure to cyanide and fluoride resulting from the proposed rulemaking.

2.3 Organization of Report

The remainder of this report is divided into four sections. Chapter 3 presents an economic profile of the aluminum industry. For this industry, available economic profile data are presented including profile of facilities, market structure, and an assessment of the market value of industry production.

Chapter 4 presents estimates of the quantity of K088 hazardous waste generated and current (baseline) and alternative compliance costs associated with hazardous waste storage, transportation, and off-site management practices. Chapter 5 documents the economic impacts of the waste management scenarios and presents a brief qualitative discussion of the economic benefits of the proposed action. Human health benefits are briefly discussed in Chapter 6.

3.0 ALUMINUM INDUSTRY PROFILE

The domestic primary aluminum industry continued to stay stable in 1997 with a slight increase in production since 1996. There are 22 active facilities and one that continues to be closed. While there is a large concentration in the Pacific Northwest (Oregon, Montana, and Washington comprise over 40%), facilities are also spread out in various parts of the country. The Industrial Midwest (Kentucky, North Carolina, South Carolina, and Tennessee comprise 20%) is another area of concentration, and other facilities are scattered elsewhere. These facilities consist of the remaining 40%. The disbursement for primary aluminum is broken down among the miscellaneous markets: transportation, containers and packaging, building and construction, electrical and consumer durables, and other uses.[3] Primary aluminum producers are listed under the North American Industrial Standard Classification (NAISC) code for Primary Aluminum Production as 331312.

3.1 Production Capacity

In Table 1, the year-end capacity is broken down into individual facilities. Regionally, Montana, Oregon, and Washington reflect a year-end capacity of 1.6 million metric tons, and the other major region consisting of Tennessee, North Carolina, South Carolina, and Kentucky have a combined year-end capacity as 716,000 metric tons. The year-end capacity of the remaining facilities which are not included in the previous regions total 1.7 million metric tons.

Several of the 13 companies also planned some type of expansion within the next year. Alumax Inc. had planned to increase spending on aluminum extrusion billet production capacity by 30% within its Frederick, MD and Ferndale, WA facilities. Noranda Aluminum Inc. had also made plans for expansion in its New Madrid, OH facility by modernizing its current primary aluminum smelter. Additionally, Reynolds Metals Co. restarted its limited production in the Troutdale, OR facility, which had been idle since 1991. By February 1998, Reynolds had planned an annual production of 27,000 tons.

[3] Plunkert, Patricia A., "Aluminum," *US Geological Survey-Minerals Information*, 1997.

TABLE 1. PRIMARY ANNUAL ALUMINUM PRODUCTION CAPACITY IN THE U.S. BY COMPANY	
Company	**Year-end Capacity (thousand metric tons)**
Alcan Aluminum Corp.	
Sebree, KY	186
Alumax Inc.	
Ferndale, WA (Intalco)	272
Frederick, MD (Eastalco)	174
Mount Holly, SC	205
Aluminum Co. of America	
Alcoa, TN	210
Badin, NC	115
Evansville, IN (Warrick)	300
Massena, NY	125
Rockdale, TX	315
Wenatchee, WA	220
Century Aluminum Co.	
Ravenswood, WV	168
Columbia Falls Aluminum Co.	
Columbia Falls, MT	168
Goldendale Aluminum Co.	
Goldendale, WA	160
Kaiser Aluminum & Chemical Corp.	
Mead, WA (Spokane)	200
Tacoma, WA	73

TABLE 1. PRIMARY ANNUAL ALUMINUM PRODUCTION CAPACITY IN THE U.S. BY COMPANY	
Company	**Year-end Capacity (thousand metric tons)**
NSA	
Hawesville, KY	186
Noranda Aluminum Inc.	
New Madrid, MO	215
Northwest Aluminum Corp.	
The Dalles, OR	82
Ormet Corp.	
Hannibal, OH	256
Reynolds Metals Co.	
Longview, WA	204
Massena, NY	123
Troutdale, OR	121
Vanalco Inc.	
Vancouver, WA	116
Total	**4,194**

Source: "Aluminum," Patricia Plunkert, *US Geological Survey- Minerals Information,* 1997.

3.2 Aluminum Statistics

The amount of aluminum produced each year reflects a steady increase since 1994 when the amount had declined sharply by approximately 400,000 metric tons. In 1997, the facilities worked to about 85% of capacity, thus creating about 3.6 million metric tons of primary aluminum. Even though there was a dip in the amount produced between 1993 and 1994, the total value has been on a constant increase ever since. In Table 2, the data showing this trend can be seen as well as the fluctuating price. In this case, it was in 1995 that the price reached its peak; then another cycle of fluctuations began to occur.

In 1997, prices rose and fell throughout the year. The average monthly US market price increased from 76.1 cents per pound in January to 80.1 cents per pound by August. However, this upward trend soon peaked and by December, the price had fallen back down to 74.7 cents per pound. The average for 1997 was 77.1 cents per pound which was higher than in 1996, which

had been 71.3 cents per pound.[4]

TABLE 2. ALUMINUM STATISTICS 1993-1997					
	1993	**1994**	**1995**	**1996**	**1997**
Primary production (thousand metric tons)	3,695	3,299	3,375	3,577	3,603
Value* (million dollars)	$4,340	$5,180	$6,390	$5,630	$6,120
Price (average cents per pound) US market (spot)	53.3	71.2	85.9	71.3	77.1

* Rounded to three significant digits.
Source: "Aluminum," Patricia Plunkert, *US Geological Survey- Minerals Information,* 1997.

3.3 Industry Size

The industry data for 1997 shows that there are 22 primary aluminum production facilities that are owned by 13 companies within the country. The industry is relatively dominated by medium sized facilities where the number of employees hover in the range between 500-999 per facility, and about two-thirds of the facilities employ less than 1,000 people. Table 3 displays this distribution.[5] Table 4 shows the distribution by employment and growth by company and Table 5 shows the distribution of sales and growth.

TABLE 3. DISTRIBUTION OF ESTABLISHMENTS BY EMPLOYMENT		
Employees	**Number of Facilities**	**Cumulative Percent of Facilities**
0-499	2	10%
500-999	14	76%
1000-2499	5	100%
Total	21	

Source: Primary Aluminum Production, Manufacturers-Industry Series, Census Bureau, Department of Commerce, 1997.

[4] ibid.
[5] ibid.

TABLE 4. EMPLOYMENT BY COMPANY*	
Company	**Number of Employees**
Alcan Aluminum Corp.	36,000
Alumax Inc.[1]	N/A
Aluminum Co. of America	103,500 (includes Alumax numbers)
Century Aluminum Co.	2,140
Columbia Falls Aluminum Co.[2]	585 (1995)
Goldendale Aluminum Co.[3]	N/A
Kaiser Aluminum & Chemical Corp.	9,200
NSA[4]	800
Noranda Aluminum Inc.	18,000
Northwest Aluminum Corp.	N/A
Ormet Corp.	3,300
Reynolds Metals Co.	20,000
Vanalco Inc.	N/A

Source: Hoover's Online.
* 1998 figures unless otherwise noted.
1. Alumax owned by Alcoa
2. Columbia Falls owned by Montana Aluminum Investors Corp.
3. Goldendale owned by Northwest Aluminum Co.
4. NSA owned by Southwire Co.

TABLE 5. TOTAL SALES BY ALUMINUM PRODUCTION COMPANY IN 1998*	
Company	**Sales (millions)**
Alcan Aluminum Corp.	$7,789
Alumax Inc.[1]	N/A
Aluminum Co. of America	$15,339.80
Century Aluminum Co.	$650.3
Columbia Falls Aluminum Co.[2]	N/A
Goldendale Aluminum Co.[3]	N/A
Kaiser Aluminum & Chemical Corp.	$2,256.4

TABLE 5. TOTAL SALES BY ALUMINUM PRODUCTION COMPANY IN 1998*	
Company	**Sales (millions)**
NSA[4]	N/A
Noranda Aluminum Inc.	$6,000*
Northwest Aluminum Corp.	N/A
Ormet Corp.	$910
Reynolds Metals Co.	$5,859
Vanalco Inc.	N/A

** Source:* All data from Hoover Online except Noranda which is taken from the Noranda web site.
1. Alumax owned by Alcoa
2. Columbia Falls owned by Montana Aluminum Investors Corp.
3. Goldendale owned by Northwest Aluminum Co.
4. NSA owned by Southwire Co.

3.4 End-Use Shipments

The allocation of primary aluminum to various industries is displayed in Table 6 where the amount and its corresponding percentages can be seen. The most aluminum went to the transportation industry with approximately 3 million tons. The next highest industry is containers and packaging with 2.2 million tons of primary aluminum.

TABLE 6. DISTRIBUTION OF END-USE SHIPMENTS OF ALUMINUM PRODUCTS BY INDUSTRY		
Industry	**Quantity (thousand metric tons)**	**Percent of Total**
Containers and packaging	2,220	21.7
Building and construction	1,320	12.9
Transportation	2,990	29.2
Electrical	708	6.9
Consumer durables	694	6.8
Machinery and equipment	626	6.1
Other markets	318	3.1
Exports (estimated)	1,360	13.2
Total	10,200	100

*note: Data are rounded to three significant digits; may not add to totals shown.
Source: "Aluminum," Patricia Plunkert, *US Geological Survey- Minerals Information,* 1997.

3.5 Exports and Imports

Tables 7 and 8 display the data for exports and imports. Table 7 shows an overall increase in the amount of exports for 1997. While exports of crude metals and alloys decreased, scrap, plates, sheets, and semi-fabricated materials exports increased. According to the US Geological Survey for 1997, Canada, Japan, and Mexico were the leading trading partners with the US, which accounted for two-thirds of US exportation.[6] Also, imports also increased in 1997 which was "reversing a downward trend" that first started in 1995.[7]

TABLE 7. EXPORTS OF ALUMINUM 1996-1997

Class	1996 Quantity (metric tons)	1996 Value (thousands)	1997 Quantity (metric tons)	1997 Value (thousands)
Crude and semi-crude:				
Metals and alloys, crude	417,000	$682,000	352,000	$606,000
Scrap	320,000	355,000	338,000	406,000
Plates, sheets, bars, strip, etc.	703,000	2,130,000	837,000	2,460,000
Castings and forgings	12,200	105,000	10,900	131,000
Semi-fabricated forms, n.e.c.	44,800	147,000	33,700	155,000
Subtotal	1,500,000	3,420,000	1,570,000	3,760,000
Manufactures:				
Foil and leaf	99,700	274,000	100,000	298,000
Powders and flakes	6,340	30,800	8,770	35,800
Wire and cable	28,500	104,000	26,500	94,100
Subtotal	134,000	410,000	136,000	428,000
Total	**1,630,000**	**3,830,000**	**1,710,000**	**4,190,000**

Source: "Aluminum," Patricia Plunkert, *US Geological Survey- Minerals Information*, 1997.

[6] ibid.

[7] ibid.

TABLE 8. IMPORTS OF ALUMINUM 1996-1997				
Class	**1996 Quantity (metric tons)**	**1996 Value (thousands)**	**1997 Quantity (metric tons)**	**1997 Value (thousands)**
Crude and semi-crude:				
Metals and alloys, crude	1,910,000	$3,040,000	2,060,000	$3,500,000
Plates, sheets, strip, etc., n.e.c.*	428,000	1,050,000	461,000	1,180,000
Pipes, tubes, etc.	11,300	54,300	14,200	72,800
Rods and bars	59,300	179,000	85,800	266,000
Scrap	402,000	460,000	454,000	574,000
Subtotal	2,810,000	4,790,000	3,080,000	5,590,000
Manufactures:				
Foil and leaf**	57,100	207,000	64,300	231,000
Powders and flakes	1,840	5,920	2,360	6,820
Wire	76,900	148,000	81,800	465,000
Subtotal	136,000	361,000	148,000	403,000
Total	**2,940,000**	**5,150,000**	**3,230,000**	**6,000,000**

* Includes plates, sheets, circles, and disks.
** Excludes etched capacitor foil.
Source: "Aluminum," Patricia Plunkert, *US Geological Survey- Minerals Information*, 1997.

4.0 WASTE GENERATION AND MANAGEMENT

As previously described, EPA is proposing establishing a treatment standard for fluoride in spent aluminum potliner (SPL, EPA waste code K088) and revising the treatment standard for cyanide in K088. In this chapter waste generation data are presented from the 1997 Biennial Report. In addition, unit cost estimates for managing the waste under baseline conditions as well as three post-regulatory management scenarios are presented.

4.1 Current Waste Generation and Management

K088 (spent potliner from primary aluminum reduction) (40 CFR 261.32) is generated by the aluminum manufacturing industry. Aluminum production occurs in four distinct steps: (1) mining of bauxite ores; (2) refining of bauxite to produce alumina; (3) reduction of alumina to aluminum metal; and (4) casting of the molten aluminum. Bauxite is refined by dissolving alumina (aluminum oxide) in a molten cryolite bath. Next, alumina is reduced to aluminum metal. This reduction process requires high purity aluminum oxide, carbon, electrical power, and an electrolytic cell. An electric current reduces the alumina to aluminum metal in electrolytic cells, called pots. These pots consist of a steel shell lined with brick with an inner lining of carbon. During the pots service the liner is degraded and broken down. Upon failure of a liner in a pot, the cell is emptied, cooled, and the lining is removed. In 1980, EPA originally listed spent potliners as a RCRA hazardous waste and assigned the hazardous waste code K088.[8]

Table 9 presents the list of 22 active aluminum smelters in the U.S. that currently generate K088.[9] The new treatment standards are expected to increase the K088 management costs at 21 of the 22 facilities. One facility, Ormet Primary Aluminum Corporation, Hannibal, Ohio, has installed the Vortec vitrification technology which has been proven to treat to the new standard. This facility will incur no incremental compliance costs related to actual management of SPL. Another facility is idle, Reynolds metals Co., Troutdale, Oregon, and is not included in the analysis.

Table 10 presents the regional distribution of aluminum smelters that generate K088. Generation quantities were obtained from the 1997 Biennial Report except for Kaiser Aluminum & Chemical Corp., Mead, Washington, where 1995 Biennial Report data were used. Approximately 41 percent (9) of the aluminum smelters accounting for 43 percent of the total K088 generation are located in the Western U.S. The largest K088 generator is located in Washington (Intalco Aluminum) which reported generating 8,681 tons (10% of total generation) in 1997.

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[8] See 45 FR 47832

[9] In addition, five active non-aluminum smelters in the U.S. reported generating K088 wastes in the 1997 BRS. These facilities will potentially incur incremental compliance costs for management of K088 wastes under the new treatment standards. However, the non-aluminum smelters are outside the scope of this analysis, which screens for economic impacts to the aluminum manufacturing industry (NAICS 331312).

TABLE 9: LIST OF AFFECTED ALUMINUM SMELTERS *

Facility Name	City	State
Alcoa -Warrick Operation	Newburgh	IN
NSA, Division of Southwire Company	Hawesville	KY
Alcan Ingot, Sebree Aluminum Plant	Henderson	KY
Eastalco Aluminum Co.	Frederick	MD
Noranda Aluminum Inc.	New Madrid	MO
Columbia Falls Aluminum Co.	Columbia Falls	MT
Aluminum Company of America /Badin Works	Badin	NC
Aluminum Company of America	Massena	NY
Reynolds Metal Co St Lawrence Red Plant	Massena	NY
Ormet Primary Aluminum Corporation	Hannibal	OH
Northwest Aluminum Company	The Dalles	OR
Alumax of SC	Goose Creek	SC
Aluminum Company of America - South Plant	Alcoa	TN
Alcoa Rockdale Works	Rockdale	TX
Kaiser Aluminum & Chemical Corp.	Mead	WA
Kaiser Aluminum Tacoma Works	Tacoma	WA
Alcoa Wenatchee Works	Malaga	WA
Intalco Aluminum Corp. Ferndale	Ferndale	WA
Reynolds Metals Longview	Longview	WA
Vanalco Inc.	Vancouver	WA
Goldendale Aluminum Co.	Goldendale	WA
Century Aluminum of WV, Inc.	Ravenswood	WV

Note: The Reynolds Metals Co., Troutdale, Oregon facility is currently idle and not included.

TABLE 10. GEOGRAPHIC DISTRIBUTION OF AFFECTED K088 GENERATORS				
State	**Number of Generators**	**Percent of Total Generators**	**Quantity Generated (tons)**	**Percent of Total Generation**
Mid-Atlantic Plants				
Maryland	1	4.5	2,469	2.81
New York	2	9.1	6,024	6.87
SUBTOTAL	**3**	**13.6**	**8,493**	**9.68**
Southeastern Plants				
Kentucky	2	9.1	6,754	7.70
North Carolina	1	4.5	1,142	1.30
South Carolina	1	4.5	2,449	2.79
Tennessee	1	4.5	1,069	1.22
West Virginia	1	4.5	6,546	7.46
SUBTOTAL	**6**	**27.3**	**17,960**	**20.47**
Gulf Plants				
Texas	1	4.5	7,090	8.08
SUBTOTAL	**1**	**4.5**	**7,090**	**8.08**
Midwestern Plants				
Indiana	1	4.5	6,069	6.92
Missouri	1	4.5	5,642	6.43
Ohio	1	4.5	5,170	5.89
SUBTOTAL	**3**	**13.6**	**16,881**	**19.24**
Western Plants				
Montana	1	4.5	4,558	5.19
Oregon [1]	1	4.5	2,939	3.35
Washington [2]	7	31.2	29,825	33.98
SUBTOTAL	**9**	**40.9**	**37,322**	**42.52**
TOTAL	**22**	**99.9**	**87,746**	**99.99**

[1] Reynolds Metals Co., Troutdale, Oregon facility is currently idle and not included.

[2] Kaiser Aluminum and Chemical Corp., Mead, Washington facility did not report generating K088 in the 1997 Biennial Report System. K088 generation data reported in the 1995 Biennial Reporting System were used instead.

Table 11 presents the reported generation quantities and management practices for K088 wastes reported by affected aluminum smelters in the 1997 Biennial Report. A total of 106,761 tons of K088 were reported managed in 1997 (including the 1995 reported quantity for Kaiser Aluminum & Chemical Corp., Mead, Washington). The current K088 treatment standards became effective in October of 1997. Therefore, several of the reported management practices (e.g., off-site incineration, on-/off-site landfill, and off-site stabilization did not meet the October 1997 standard. This created a shift in management practices at the end of 1997 to the Reynolds' thermal treatment plant in Gum Springs, Arkansas, and Chem Waste Management's on-site storage facility in Oporlliam, Oregon.

TABLE 11. CURRENT 1997 K088 MANAGEMENT [1]

Management Method	1997 Managed Quantity (tons)	Percent of Total Generation
off-site thermal treatment (Reynolds, Gum Springs, Arkansas)	37,021.4	
Assume the following technologies were used prior to the October 1997 LDR Treatment Standard and are now shipped to Gum Springs:		
off-site incineration	7.5	
on-site landfill	8084.0	
off-site stabilization	190.0	
off-site landfill	18,347.8	
off-site other disposal	0.2	
off-site high temperature metals recovery	104.0	
off-site aqueous treatment	1.2	
on-site transfer facility	39.0	
off-site transfer facility	73.8	
unspecified management	126.0	
SUBTOTAL	63,994.9	72.9%
off-site storage (Chem Waste Management, Oporlliam, Oregon)	23,797.5	27.1%
ANNUAL K088 MANAGEMENT TOTAL	**87,792.4**	**100.0%**
ONE-TIME MANAGEMENT QUANTITY (Backlog in On-site Storage)	**1997-2001 Stored Quantity 20,000 [2] - 143,000 [3]**	**---**

Source: 1997 and 1995 (for Kaiser Aluminum & Chemical Corp., Mead, WA) Biennial Reporting System databases.

Notes:

[1] LDR treatment standards for K088 became effective October 1997. Therefore, the 1997 management picture is a mixture of RCRA regulatory requirements.

[2] Per communication with John Austin, U.S. EPA, Office of Solid Waste, September 1999.

[3] Assume 23,000 tons shipped to Chem Waste Management in 1997 and 30,000 tons annually between 1998 and 2001.

4.2 Waste Management Costs

Baseline waste management unit costs are presented in Table 12. These unit costs are used in completing the economic impact analysis. Transportation distances were calculated using Internet-based Mapquest software. These unit costs are consistent with the 1998 interim status K088 treatment standards ruling.

TABLE 12. K088 BASELINE MANAGEMENT AND ANALYTICAL UNIT COSTS

Baseline Management Method	Baseline Unit Cost ($/ton)
Off-Site Thermal Treatment (Reynolds, Gum Springs, Arkansas)	$200 - $500 [1]
Off-Site Storage (Chem Waste Management, Oporlliam, Oregon)	$245 [2] treatment = $80 disposal = $80 storage = $85
Transportation, van trailer (solid)	$683.33 minimum charge [3] $2.41/mi., 200-299 mi. $2.31/mi., 300-399 mi. $2.11/mi., 400-499 mi. $2.01/mi., 500-599 mi. $1.98/mi., 600-699 mi. $1.91/mi., 700-799 mi. $1.87/mi., 1,000+ mi.
Analytical Costs Cyanide TCLP	$82/analytical test [4]

[1] Federal Register, Volume 63, Number 185, September 24, 1998, pp. 51260; 1994 price quote. Price quote still valid based on communication between Linda Martin, U.S. EPA, Office of Solid Waste and Reynolds in 1999.

[2] Federal Register, Volume 63, Number 185, September 24, 1998, pp. 51260; 1998 price quote.

[3] Environmental Cost Handling Options and Solutions (ECHOS), Environmental Remediation Cost Data-Unit Price, 5th Annual Edition, published by R.S. Means, 1999, Assembly #33 19 0229 through 0240.

[4] Vendor quote from EnChem Inc., November 17, 1999.

Table 13 presents the estimated compliance management unit costs used in the economic impact screening analysis. Crusher and hammer mill unit costs were developed by scaling vendor cost estimates received from Nordberg, Inc. assuming a 7 percent discount rate (consistent with OMB Circular No. A-94, October, 1992), 10-year equipment life, 20-year plant life, and a 30 percent profit margin. The Vortec technology is the only proven technology that can meet the new treatment standards. One 36 ton per day plant has been constructed in Paducah, Kentucky, in 1996 for the DOE at a cost $11.6 million. Assuming operating costs of between $150 - $300/ton similar to the NHW vitrification system, a 7 percent discount rate, 20-year equipment life, 20-year plant life, 3 percent annual inflation, and 30 percent profit, the unit commercial price would range

between $330/ton and $550/ton (excluding crushing and milling equipment). EPA believes that vitrification and incineration vendors can set up their process to receive and treat K088 if they buy crushers and mills to reduce the size of the K088 blocks of waste (e.g., potentially up to 3 feet in length) enabling it to be fed into their technologies. Therefore, published commercial prices for vitrification ($300/ton) and incineration ($650/ton) were used as potential price ceilings for the vortec technology in the market when new capacity is constructed. Estimates of commercial crushing ($25/ton to $47/ton) and milling ($41/ton to $79/ton) prices are added to the vitrification and incineration prices to determine the total compliance management unit cost. Assuming two crushing units, one hammer mill, and a vitrification unit, commercial prices range from $391/ton to $473/ton. Similarly, assuming two crushing units, one hammer mill, and an incineration unit, commercial prices range from $741/ton to $823/ton.

TABLE 13. K088 COMPLIANCE MANAGEMENT UNIT COSTS

Compliance Management Method	Compliance Unit Cost ($/ton)
Crushers (assume one of each unit)(estimated commercial price): 1 - 30" x 42" jaw crusher (150 hp motor) [1] 1 - 78" x 40" impact mill (150 hp motor) [1]	Same unit price per unit: [6] 5,000 tpy = $47/ton/unit 10,000 tpy = $39/ton/unit 30,000 tpy = $31/ton/unit 55,000 tpy = $27/ton/unit 85,000 tpy = $25/ton/unit
Hammer Mill (10,000 tons/year; +200 mesh to 1" initial size)	Price per unit: [6] 5,000 tpy = $79/ton 10,000 tpy = $66/ton 30,000 tpy = $51/ton 55,000 tpy = $45/ton 85,000 tpy = $41/ton
Off-site Vitrification (ground solid) ECHOS (in situ soil vitrification) [8] NHW Vitrification System (3,000 tons/year) [2] Capital Costs ($1,000,000) Operating Costs ($150/ton - $300/ton) GeoMelt Vitrification [4]	assume $300/ton $300/ton $240 - $430/ton [3] $370 - $420/ton
Off-site Incineration (ground solid)	$650/ton [7] to $1,300/ton [8]
On-site Vortec Technology (Goldendale Technology assumed to be similar in price; estimated cost for noncommercial crusher, impact mill and hammer mill added into unit cost): Capital: $11,600,000 for 36 ton of soil/day facility ($1996) [9] License Agreement: $5 to $10 million/municipal ash facility, size unspecified [10]	Price per unit: [11] 1,000 tpy = $527/ton 3,000 tpy = $431/ton 5,000 tpy = $431/ton 7,000 tpy = $451/ton 10,000 tpy = $496/ton

TABLE 13. K088 COMPLIANCE MANAGEMENT UNIT COSTS	
Compliance Management Method	**Compliance Unit Cost ($/ton)**
Transportation, van trailer (solid)	$683.33 minimum charge [5] $2.41/mi., 200-299 mi. $2.31/mi., 300-399 mi. $2.11/mi., 400-499 mi. $2.01/mi., 500-599 mi. $1.98/mi., 600-699 mi. $1.91/mi., 700-799 mi. $1.87/mi., 1,000+ mi.
Analytical Costs: Cyanide Total Fluoride TCLP	 $22/analytical test [12] $74/analytical test [12]
Incinerator RCRA/MACT Permit (assumed similar to the cost of permitting the Vortec and Goldendale Processes): Initial Permit Renewal of Permit (every 10 years)	 $350,000/facility [13] $130,000/facility/10-years [13]

1 Reynolds Metals Company Spent Potliner Treatment Plant, http://www.rmc.com/gbu/metals/gum_spr.html.

2 NHW Home Page, http://www.qn.net/~nhw/nhwtoc.html.

3 Annualized capital cost using a capital recovery factor based on a 7 percent real discount rate and 20-year operating life. Assumed a 30 percent profit margin.

4 GeoMelt Comparison with Alternative Technology Types, http://www.geomelt.com/geomeltnf_comparison_with_alternat.htm.

5 Environmental Cost Handling Options and Solutions (ECHOS), Environmental Remediation Cost Data-Unit Price, 5th Annual Edition, published by R.S. Means, 1999, Assembly #33 19 0229 through 0240.

6 EPA derived cost based on scaling of vendor quotes from Nordberg. Inc.. Assumed a plant life of 20 years (equipment life of 10 years) and a 30 percent profit margin for commercial operation.

7 Per communication with author of Environmental Cost Handling Options and Solutions (ECHOS), Environmental Remediation Cost Data-Unit Price, 5th Annual Edition, published by R.S. Means, 1999, average unit cost of $1,300/ton is skewed given conservative unit price quotes received from commercial incinerators. $650/ton is more reasonable unit price estimate if outliers removed from average.

8 Environmental Cost Handling Options and Solutions (ECHOS), Environmental Remediation Cost Data-Unit Price, 5th Annual Edition, published by R.S. Means, 1999.

9 Vortec, http://www.vortec-cms.com/paducah.htm

10 "Montgomery County Green Technology News Clips", Louis S. Hansen, Philadelphia Inquirer, July 22, 1996; http://www.ehb.state.pa.us/dep/counties/Montgomery/Green_Technology_News.htm. Vortec licensed its technology to Japan's Mitsubishi Kasei Engineering Co. for treatment of municipal incinerator ash with the agreement bringing Vortec between $5 and $10 million for each plant built.

11 One 36 tons of soil per day plant has been constructed in Paducah, Kentucky, in 1996 for the DOE at a cost $11.6 million. EPA scaled capital costs using a scaling factor of 0.6. Assumed operating costs of at the high end of $150 - $300/ton range estimated for the NHW vitrification system. EPA scaled operating costs using a scaling factor of 0.9. Assumed a 7 percent discount rate, 20-year equipment life, 20-year plant life, and 3 percent annual inflation. Assumed an initial licensing fee of $200,000 and an annual licensing fee equivalent to 10% of annual cost savings (assumed to be annual quantity of waste times $300/ton to treat waste) over a 10-year period. Includes a crusher, impact mill, and hammer mill (see footnote 6 except exclude profit margin).

12 Vendor quote from EnChem Inc., November 17, 1999.

[13] EPA, Office of Solid Waste, Cost and Economic Impact Analysis of Listing Hazardous Wastes from the Petroleum Refining Industry, prepared by DPRA Incorporated, September 21, 1995. The 1992 cost estimates were inflated to 1999 dollars assuming a 4 percent annual rate of inflation.

4.3 Waste Treatment Processes

Vortec

The Vortec process is a direct-fired vitrification system that destroys cyanide and other organic compounds contained in K088 waste, while recovering the fluoride values for use. K088 waste is mixed with sand and limestone and vitrified to form a glass-like residue or frit. The treatment process does not immobilize the fluoride in the glass matrix, but, it effectively partitions the fluoride into the baghouse dust for reuse back into the aluminum reduction pots.

The process unit performing this vitrification process is referred to as a combustion melting system (CMS) and consists of a Counter Rotating Vortec (CRV) Reactor, a cyclone melter and a separator/reservoir. The finely crushed K088 waste, sand and limestone mixture are preheated in a rapid suspension heating system before physical and chemical melting, which occurs within the cyclone reactor. The reactor is a refractory-lined, carbon steel, water-cooled vessel. Natural gas and preheated air are used to achieve temperatures of approximately 2,400 F in the reactor. Materials begin to melt in the reactor and flow downward to the cyclone melter. Melting of the waste and other additives, as well as combustion of the cyanide and other organic compounds, is completed in this vessel and the resultant molten glass is separated from the gas. The separated gas is used to preheat the air entering the reactor, and is then sent to a primary baghouse to remove particulate matter, primarily sodium fluoride. The exhaust from the baghouse is then transferred into the potroom "secondary" dry scrubber system (a baghouse air pollution device using alumina to dry scrub fluoride from aluminum reduction pot exhaust gas) where gaseous fluoride is removed and additional particulate removal occurs. The material from the primary and secondary baghouse systems are fluoride-enriched alumina material which is charged back into the aluminum pots. The molten glass is dropped into a water quench tank where it solidifies into a glass-like residue or frit. This process is referred to as K088 vitrification.

Currently, only the Ormet facility in Ohio operates the Vortec process. The frit, a granular glass-like material, that they generate is presently shipped off the site as industrial-grade glass. Ormet generates approximately 6,500 short tons annually.

Goldendale

The Goldendale process is a vitrification system that destroys cyanide and other organic compounds contained in K088 waste, while recovering the fluoride values for use. K088 waste is digested with acid to produce hydrogen fluoride and hydrogen cyanide gas leaving a slurry of carbon, silica, alumina, sodium compounds, aluminum compounds, iron compounds, magnesium compounds and calcium compounds. Ultimately the slurry component is vitrified into refractory material. The cyanide gas is thermally oxidized at high temperature into carbon dioxide, water and nitrogen. The treatment process does not immobilize the fluoride within the refractory

material but partitions the hydrogen fluoride gas into the wet scrubber creating a hydrofluoric acid. The hydrofluoric acid is then admixed with alumina trihydrate to form aluminum fluoride and water.

Crushed K088 waste is introduced into an acid digester containing an acid such as sulfuric acid. The acid digester produces a gas component and a slurry component. The gas component includes hydrogen fluoride and hydrogen cyanide. It is heated to a temperature sufficient to decompose hydrogen cyanide thereby producing a gas component substantially free of cyanide and includes offgases consisting of carbon dioxide, water, nitrogen and hydrogen fluoride gas. Next the gas component is combined with water in a wet scrubber to form hydrofluoric acid. The hydrofluoric acid is mixed with alumina trihydrate to form aluminum fluoride.

The slurry component is rinsed with water and then a first solid fraction is separated consisting of carbon, alumina and silica. The pH is then adjusted forming a basic solution. Impurities consisting of calcium, iron and magnesium are precipitated and filtered from the slurry component. The pH is then adjusted forming an acidic solution resulting in the precipitation of aluminum trihydrate from the slurry. The remaining slurry is then subjected to an elevated temperature in an oxygen-rich atmosphere to oxidize the carbon and vitrify alumina and silica into refractory material.

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5.0 ECONOMIC IMPACT ANALYSIS

5.1 Methodology

An economic impact analysis of the proposed rulemaking was conducted by using the incremental management unit costs derived in Chapter 4.0 of this report in conjunction with annual industry sales, and estimated waste generation rates. Individual facilities were considered in the analysis. Annual sales for each facility were estimated from overall industry production data and industry capacity. Total industry capacity estimates were taken from the USGS data presented in Chapter 2, Table 1. Industry production (Table 2) divided by industry capacity determined the overall capacity utilization. Sales for each facility were approximated assuming that they each produced aluminum at this capacity utilization rate of approximately 88 percent.

Costs are estimated for each of the individual smelters based on their current waste generation and management, as reported in the 1997 Biennial Report. Both baseline and post regulatory cost estimates are based on the unit cost estimates set forth in Chapter 4.0.

5.2 Estimated Impacts on Sales

The impact estimates presented in this chapter correspond with three waste management scenarios, which define the most likely K088 treatment facilities. These scenarios are:

Scenario 1 Assumes two facilities will be available for treating K088, one owned by Reynolds Aluminum, Gum Springs, Arkansas, and one storage facility owned by Chemical Waste Management in Oregon. Both facilities are assumed to be retrofitted (Reynolds using the Vortec technology and Chemical Waste Management using the Goldendale process) to meet the revised treatment standards;

Scenario 2 Assumes only the treatment facility owned by Reynolds Aluminum, Gum Springs, Arkansas will be available. This facility is assumed to be retrofitted using the Vortec technology; and

Scenario 3 Assumes that facilities in the Pacific Northwest treat on site using either Vortec or Goldendale (using a cost structure similar to the Ormet facility in Hannibal, Ohio), and assumes that the Reynolds facility will be retrofitted using the Vortec technology.

Impact estimates are presented for the three scenarios for both annual generation of K088 from all of the active aluminum smelters (as reported in the 1997 Biennial Reporting System (BRS)) as well as for treatment of K088 that is being stored at the Waste Management facility in Oregon. As in the management of K088 produced annually, disposal options for the stored K088 are considered under three facility options as described above. In addition costs were estimated based on a range of waste volumes stored (20,000 and 143,000 tons). The impacts are presented as a percent of sales for each of the scenarios for both the annually generated K088 as well as the K088 currently in storage.

In order to estimate impacts as a percent of sales, actual sales values for each of the smelters were estimated. For the industry as a whole, total production in 1997 was almost 4.0 million tons of metal. Production capacity for the smelters reporting generation of K088 in 1997 was estimated at almost 4.5 million tons, implying a capacity utilization of 88 percent. To estimate production each facility was assumed to be operating at 88 percent of capacity, and sales were estimated using the average aluminum price reported in 1997.

For management Scenario 1, annual cost impacts are estimated to range from approximately 0.2 to 0.5 percent of sales, or $15.1 to $29.7 million in aggregate cost for all facilities. It is important to note that impacts on some facilities are substantially higher, ranging to above 1.5 percent of sales. These unusually high impact estimates stem from very high and questionable waste generation estimates reported in the BRS. For instance the ALCOA smelter in New York reported generating 23,208 tons of K088 as "oil-water emulsion or mixture." Costs for the one-time management of stored K088 are estimated to range from $36.1 to $86.2 million for the eight facilities with waste currently held in storage. Impacts for each facility are shown in Tables 14 and 15 from Scenario 1.

For management Scenario 2, annual cost impacts are higher (0.4 to 0.7 percent of sales) due to the cost of shipping the K088 from smelters in the Northwest to Gum Springs, Arkansas. Total costs for managing annually generated K088 are estimated to range from $26.1 to $40.7 million, as shown in Table 16. One-time costs for the management of currently stored waste are presented in Table 17.

Annual cost impacts under Scenario 3 (0.3 percent of sales) are presented in Table 18. These cost estimates are generally lower than the costs under the other scenarios, indicating that for the facilities in the Northwest, it is less costly to construct treatment facilities on site than ship the K088 to Arkansas. However for the one-time management costs presented in Table 19, cost estimates are based on the assumption that the K088 currently in storage would need to be shipped to the Reynolds facility in Arkansas, because this material would need to go to a commercially licensed facility. All for the facilities constructed under Scenario 3 are assumed to be non-commercial.

TABLE 14. IMPACT ON SALES ESTIMATES FOR MANAGEMENT OF K088 GENERATED ANNUALLY UNDER SCENARIO 1								
	Managed	Facility	Facility	Facility	Low Impact	High Impact	Low	High
Facility	K088	Sales	Sales	Capacity	Estimate	Estimate	Estimate	Estimate
	(tons)	($1,000)	(tons)	(tons)			% of Sales	% of Sales
ALCOA -WARRICK OPER	6,069	450,432	291,920	330,000	$1,216,015	$1,519,465	0.3%	0.3%
NSA, DIVISION OF SOUTHWIRE CO.	3,096	279,268	180,990	204,600	$620,313	$775,109	0.2%	0.3%
ALCAN INGOT, SEBREE ALUMINUM PLANT	3,658	279,268	180,990	204,600	$732,935	$915,835	0.3%	0.3%
EASTALCO ALUMINUM CO	2,469	261,251	169,314	191,400	$489,392	$612,842	0.2%	0.2%
NORANDA ALUMINUM INC	5,643	322,810	209,209	236,500	$1,130,559	$1,412,684	0.4%	0.4%
COLUMBIA FALLS ALUMINUM CO	4,558	252,242	163,475	184,800	$784,234	$2,379,639	0.3%	0.9%
ALUMINUM COMPANY OF AMERICA /BADIN WORKS	1,142	172,666	111,903	126,500	$227,746	$284,824	0.1%	0.2%
ALUMINUM COMPANY OF AMERICA	2,043	187,680	121,633	137,500	$404,979	$507,119	0.2%	0.3%
REYNOLDS METALS CO ST LAWRENCE RED PLANT	3,981	184,677	119,687	135,300	$789,211	$988,261	0.4%	0.5%
ORMET PRIMARY ALUMINUM CORPORATION	5,170	384,369	249,105	281,600	$59,651	$59,651	0.0%	0.0%
NORTHWEST ALUMINUM COMPANY	2,939	123,118	79,791	90,200	$507,121	$1,535,882	0.4%	1.2%
ALUMAX OF SC	2,449	307,796	199,479	225,500	$488,273	$610,698	0.2%	0.2%
ALUMINUM COMPANY OF AMERICA-SOUTH PLANT	1,069	315,303	204,344	231,000	$204,844	$258,314	0.1%	0.1%
ALCOA ROCKDALE WORKS	7,090	472,954	306,516	346,500	$1,366,169	$1,720,658	0.3%	0.4%
KAISER ALUMINUM TACOMA WORKS	2,253	109,605	71,034	80,300	$386,007	$1,182,227	0.4%	1.1%
ALCOA WENATCHEE WORKS	2,469	330,317	214,075	242,000	$382,250	$1,170,723	0.1%	0.4%
INTALCO ALUMINUM CORP FERNDALE	8,681	408,392	264,674	299,200	$61,862	$185,297	0.0%	0.0%
KAISER ALUMINUM & CHEMICAL CORP	2,275	300,288	194,613	220,000	$1,457,718	$4,495,905	0.5%	1.5%
REYNOLDS METALS LONGVIEW	4,987	306,294	198,506	224,400	$891,056	$2,636,599	0.3%	0.9%
VANALCO INC	2,634	174,167	112,876	127,600	$467,083	$1,388,883	0.3%	0.8%
GOLDENDALE ALUMINUM CO	6,527	240,231	155,691	176,000	$1,123,208	$3,407,788	0.5%	1.4%
CENTURY ALUMINUM OF WV, INC.	6,546	252,242	163,475	184,800	$1,286,779	$1,614,079	0.5%	0.6%
Totals	**87,746**	**6,115,372**	**3,963,300**	**4,480,300**	**$15,077,403**	**$29,662,482**	**0.2%**	**0.5%**

TABLE 15. IMPACT ON SALES ESTIMATES FOR MANAGEMENT OF K088 CURRENTLY IN STORAGE UNDER SCENARIO 1 *								
Facility	Managed K088* (tons)	Facility Sales ($1,000)	Facility Sales (tons)	Facility Capacity (tons)	Low Impact Estimate	High Impact Estimate	Low Estimate % of Sales	High Estimate % of Sales
ALCOA -WARRICK OPER	0	450,432	291,920	330,000	$0	$0	0.0%	0.0%
NSA, DIVISION OF SOUTHWIRE CO.	0	279,268	180,990	204,600	$0	$0	0.0%	0.0%
ALCAN INGOT, SEBREE PLANT	0	279,268	180,990	204,600	$0	$0	0.0%	0.0%
EASTALCO ALUMINUM CO	0	261,251	169,314	191,400	$0	$0	0.0%	0.0%
NORANDA ALUMINUM INC	0	322,810	209,209	236,500	$0	$0	0.0%	0.0%
COLUMBIA FALLS ALUMINUM CO	19,085	252,242	163,475	184,800	$4,822,490	$11,502,076	1.9%	4.6%
ALUMINUM COMPANY OF AMERICA /BADIN WORKS	0	172,666	111,903	126,500	$0	$0	0.0%	0.0%
ALUMINUM COMPANY OF AMERICA	0	187,680	121,633	137,500	$0	$0	0.0%	0.0%
REYNOLDS METALS CO ST LAWRENCE RED PLANT	0	184,677	119,687	135,300	$0	$0	0.0%	0.0%
ORMET PRIMARY ALUMINUM CORPORATION	0	384,369	249,105	281,600	$0	$0	0.0%	0.0%
NORTHWEST ALUMINUM COMPANY	12,306	123,118	79,791	90,200	$3,109,675	$7,416,857	2.5%	6.0%
ALUMAX OF SC	0	307,796	199,479	225,500	$0	$0	0.0%	0.0%
ALUMINUM COMPANY OF AMERICA-SOUTH PLANT	0	315,303	204,344	231,000	$0	$0	0.0%	0.0%
ALCOA ROCKDALE WORKS	0	472,954	306,516	346,500	$0	$0	0.0%	0.0%
KAISER ALUMINUM TACOMA WORKS	9,431	109,605	71,034	80,300	$1,667,302	$3,976,666	1.5%	3.6%
ALCOA WENATCHEE WORKS	0	330,317	214,075	242,000	$2,383,347	$5,684,498	0.7%	1.7%
INTALCO ALUMINUM CORP FERNDALE	36,343	408,392	264,674	299,200	$0	$0	0.0%	0.0%
KAISER ALUMINUM & CHEMICAL CORP	6,598	300,288	194,613	220,000	$9,183,642	$21,903,819	3.1%	7.3%
REYNOLDS METALS LONGVIEW	20,880	306,294	198,506	224,400	$5,276,318	$12,584,497	1.7%	4.1%
VANALCO INC	11,026	174,167	112,876	127,600	$2,786,360	$6,645,721	1.6%	3.8%
GOLDENDALE ALUMINUM CO	27,328	240,231	155,691	176,000	$6,905,683	$16,470,682	2.9%	6.9%
CENTURY ALUMINUM OF WV, INC.	0	252,242	163,475	184,800	$0	$0	0.0%	0.0%
Totals	**143,000**	**6,115,372**	**3,963,300**	**4,480,300**	**$36,134,816**	**$86,184,816**	**0.6%**	**1.4%**

* Waste in storage is estimated to range from 20,000 to 143,000 tons (the latter of which is shown here). The cost impact range is estimated based on 20,000 tons (Low Impact Estimate) and 143,000 tons (High Impact Estimate).

TABLE 16. IMPACT ON SALES ESTIMATES FOR MANAGEMENT OF K088 GENERATED ANNUALLY UNDER SCENARIO 2								
	Managed	**Facility**	**Facility**	**Facility**	**Low Impact**	**High Impact**	**Low**	**High**
Facility	**K088**	**Sales**	**Sales**	**Capacity**	**Estimate**	**Estimate**	**Estimate**	**Estimate**
	(tons)	**($1,000)**	**(tons)**	**(tons)**			**% of Sales**	
ALCOA -WARRICK OPER	6,069	450,432	291,920	330,000	$1,563,801	$1,867,251	0.3%	0.4%
NSA, DIVISION OF SOUTHWIRE CO.	3,096	279,268	180,990	204,600	$797,725	$952,521	0.3%	0.3%
ALCAN INGOT, SEBREE PLANT	3,658	279,268	180,990	204,600	$942,558	$1,125,458	0.3%	0.4%
EASTALCO ALUMINUM CO	2,469	261,251	169,314	191,400	$630,879	$754,329	0.2%	0.3%
NORANDA ALUMINUM INC	5,643	322,810	209,209	236,500	$1,453,905	$1,736,030	0.5%	0.5%
COLUMBIA FALLS ALUMINUM CO	4,558	252,242	163,475	184,800	$1,625,408	$3,220,813	0.6%	1.3%
ALUMINUM COMPANY OF AMERICA /BADIN WORKS	1,142	172,666	111,903	126,500	$293,163	$350,241	0.2%	0.2%
ALUMINUM COMPANY OF AMERICA	2,043	187,680	121,633	137,500	$522,042	$624,182	0.3%	0.3%
REYNOLDS METALS CO ST LAWRENCE RED PLANT	3,981	184,677	119,687	135,300	$1,017,344	$1,216,394	0.6%	0.7%
ORMET PRIMARY ALUMINUM CORPORATION	5,170	384,369	249,105	281,600	$59,651	$59,651	0.0%	0.0%
NORTHWEST ALUMINUM COMPANY	2,939	123,118	79,791	90,200	$1,208,846	$2,237,607	1.0%	1.8%
ALUMAX OF SC	2,449	307,796	199,479	225,500	$628,586	$751,011	0.2%	0.2%
ALUMINUM COMPANY OF AMERICA-SOUTH PLANT	1,069	315,303	204,344	231,000	$266,127	$319,597	0.1%	0.1%
ALCOA ROCKDALE WORKS	7,090	472,954	306,516	346,500	$1,772,452	$2,126,941	0.4%	0.4%
KAISER ALUMINUM TACOMA WORKS	2,253	109,605	71,034	80,300	$873,686	$1,669,907	0.8%	1.5%
ALCOA WENATCHEE WORKS	2,469	330,317	214,075	242,000	$904,985	$1,693,458	0.3%	0.5%
INTALCO ALUMINUM CORP FERNDALE	8,681	408,392	264,674	299,200	$627,657	$751,092	0.2%	0.2%
KAISER ALUMINUM & CHEMICAL CORP	2,275	300,288	194,613	220,000	$3,463,515	$6,501,702	1.2%	2.2%
REYNOLDS METALS LONGVIEW	4,987	306,294	198,506	224,400	$2,033,355	$3,778,898	0.7%	1.2%
VANALCO INC	2,634	174,167	112,876	127,600	$1,074,483	$1,996,283	0.6%	1.1%
GOLDENDALE ALUMINUM CO	6,527	240,231	155,691	176,000	$2,684,315	$4,968,894	1.1%	2.1%
CENTURY ALUMINUM OF WV, INC.	6,546	252,242	163,475	184,800	$1,661,901	$1,989,201	0.7%	0.8%
Totals	**87,746**	**6,115,372**	**3,963,300**	**4,480,300**	**$26,106,382**	**$40,691,461**	**0.4%**	**0.7%**

TABLE 17. IMPACT ON SALES ESTIMATES FOR MANAGEMENT OF K088 CURRENTLY IN STORAGE UNDER SCENARIO 2 *								
Facility	Managed K088* (tons)	Facility Sales ($1,000)	Facility Sales (tons)	Facility Capacity (tons)	Low Impact Estimate	High Impact Estimate	Low Estimate % of Sales	High Estimate
ALCOA -WARRICK OPER	0	450,432	291,920	330,000	$0	$0	0.0%	0.0%
NSA, DIVISION OF SOUTHWIRE CO.	0	279,268	180,990	204,600	$0	$0	0.0%	0.0%
ALCAN INGOT, SEBREE PLANT	0	279,268	180,990	204,600	$0	$0	0.0%	0.0%
EASTALCO ALUMINUM CO	0	261,251	169,314	191,400	$0	$0	0.0%	0.0%
NORANDA ALUMINUM INC	0	322,810	209,209	236,500	$0	$0	0.0%	0.0%
COLUMBIA FALLS ALUMINUM CO	19,085	252,242	163,475	184,800	$9,235,466	$15,915,052	3.7%	6.3%
ALUMINUM COMPANY OF AMERICA /BADIN WORKS	0	172,666	111,903	126,500	$0	$0	0.0%	0.0%
ALUMINUM COMPANY OF AMERICA	0	187,680	121,633	137,500	$0	$0	0.0%	0.0%
REYNOLDS METALS CO ST LAWRENCE RED PLANT	0	184,677	119,687	135,300	$0	$0	0.0%	0.0%
ORMET PRIMARY ALUMINUM CORPORATION	0	384,369	249,105	281,600	$0	$0	0.0%	0.0%
NORTHWEST ALUMINUM COMPANY	12,306	123,118	79,791	90,200	$5,954,665	$10,261,847	4.8%	8.3%
ALUMAX OF SC	0	307,796	199,479	225,500	$0	$0	0.0%	0.0%
ALUMINUM COMPANY OF AMERICA-SOUTH PLANT	0	315,303	204,344	231,000	$0	$0	0.0%	0.0%
ALCOA ROCKDALE WORKS	0	472,954	306,516	346,500	$0	$0	0.0%	0.0%
KAISER ALUMINUM TACOMA WORKS	9,431	109,605	71,034	80,300	$3,193,653	$5,503,017	2.9%	5.0%
ALCOA WENATCHEE WORKS	0	330,317	214,075	242,000	$4,566,246	$7,867,398	1.4%	2.4%
INTALCO ALUMINUM CORP FERNDALE	36,343	408,392	264,674	299,200	$0	$0	0.0%	0.0%
KAISER ALUMINUM & CHEMICAL	6,598	300,288	194,613	220,000	$17,588,416	$30,308,593	5.9%	10.1%
REYNOLDS METALS LONGVIEW	20,880	306,294	198,506	224,400	$10,105,416	$17,413,595	3.3%	5.7%
VANALCO INC	11,026	174,167	112,876	127,600	$5,335,337	$9,194,698	3.1%	5.3%
GOLDENDALE ALUMINUM CO	27,328	240,231	155,691	176,000	$13,224,565	$22,789,563	5.5%	9.5%
CENTURY ALUMINUM OF WV, INC.	0	252,242	163,475	184,800	$0	$0	0.0%	0.0%
Totals	**143,000**	**6,115,372**	**3,963,300**	**4,480,300**	**$69,203,764**	**$119,253,764**	**1.1%**	**2.0%**

* Waste in storage is estimated to range from 20,000 to 143,000 tons (the latter of which is shown here). The cost impact range is estimated based on 20,000 tons (Low Impact Estimate) and 143,000 tons (High Impact Estimate).

TABLE 18. IMPACT ON SALES ESTIMATES FOR MANAGEMENT OF K088 GENERATED ANNUALLY UNDER SCENARIO 3 *								
Facility	Managed K088 (tons)	Facility Sales ($1,000)	Facility Sales (tons)	Facility Capacity (tons)	Low Impact Estimate	High Impact Estimate	Low Estimate % of Sales	High Estimate
ALCOA -WARRICK OPER	6,069	450,432	291,920	330,000	$1,216,015	$1,519,465	0.3%	0.3%
NSA, DIVISION OF SOUTHWIRE COMPANY	3,096	279,268	180,990	204,600	$620,313	$775,109	0.2%	0.3%
ALCAN INGOT, SEBREE ALUMINUM PLANT	3,658	279,268	180,990	204,600	$732,935	$915,835	0.3%	0.3%
EASTALCO ALUMINUM CO	2,469	261,251	169,314	191,400	$489,392	$612,842	0.2%	0.2%
NORANDA ALUMINUM INC	5,643	322,810	209,209	236,500	$1,130,559	$1,412,684	0.4%	0.4%
COLUMBIA FALLS ALUMINUM CO	4,558	252,242	163,475	184,800	$873,543	$873,543	0.3%	0.3%
ALUMINUM COMPANY OF AMERICA /BADIN WORKS	1,142	172,666	111,903	126,500	$227,746	$284,824	0.1%	0.2%
ALUMINUM COMPANY OF AMERICA	2,043	187,680	121,633	137,500	$404,979	$507,119	0.2%	0.3%
REYNOLDS METALS CO ST LAWRENCE RED PLANT	3,981	184,677	119,687	135,300	$789,211	$988,261	0.4%	0.5%
ORMET PRIMARY ALUMINUM CORPORATION	5,170	384,369	249,105	281,600	$59,651	$59,651	0.0%	0.0%
NORTHWEST ALUMINUM COMPANY	2,939	123,118	79,791	90,200	$736,638	$736,638	0.6%	0.6%
ALUMAX OF SC	2,449	307,796	199,479	225,500	$488,273	$610,698	0.2%	0.2%
ALUMINUM COMPANY OF AMERICA-SOUTH PLANT	1,069	315,303	204,344	231,000	$204,844	$258,314	0.1%	0.1%
ALCOA ROCKDALE WORKS	7,090	472,954	306,516	346,500	$1,366,169	$1,720,658	0.3%	0.4%
KAISER ALUMINUM TACOMA WORKS	2,253	109,605	71,034	80,300	$577,283	$577,283	0.5%	0.5%
ALCOA WENATCHEE WORKS	2,469	330,317	214,075	242,000	$562,379	$562,379	0.2%	0.2%
INTALCO ALUMINUM CORP FERNDALE	8,681	408,392	264,674	299,200	$249,002	$0	0.1%	0.0%
KAISER ALUMINUM & CHEMICAL CORP	2,275	300,288	194,613	220,000	$1,990,442	$1,990,442	0.7%	0.7%
REYNOLDS METALS LONGVIEW	4,987	306,294	198,506	224,400	$1,084,822	$1,084,822	0.4%	0.4%
VANALCO INC	2,634	174,167	112,876	127,600	$653,387	$653,387	0.4%	0.4%
GOLDENDALE ALUMINUM CO	6,527	240,231	155,691	176,000	$1,577,682	$1,577,682	0.7%	0.7%
CENTURY ALUMINUM OF WV, INC.	6,546	252,242	163,475	184,800	$1,286,779	$1,614,079	0.5%	0.6%
Totals	**87,748**	**6,115,372**	**3,963,300**	**4,480,300**	**$17,322,043**	**$19,335,714**	**0.3%**	**0.3%**

TABLE 19. IMPACT ON SALES ESTIMATES FOR MANAGEMENT OF K088 CURRENTLY IN STORAGE UNDER SCENARIO 3 *								
	Managed	Facility	Facility	Facility	Low Impact	High Impact	Low	High
Facility	K088	Sales	Sales	Capacity	Estimate	Estimate	Estimate	Estimate
	(tons)	($1,000)	(tons)	(tons)			% of Sales	
ALCOA -WARRICK OPER	0	450,432	291,920	330,000	$0	$0	0.0%	0.0%
NSA, DIVISION OF SOUTHWIRE COMPANY	0	279,268	180,990	204,600	$0	$0	0.0%	0.0%
ALCAN INGOT, SEBREE ALUMINUM PLANT	0	279,268	180,990	204,600	$0	$0	0.0%	0.0%
EASTALCO ALUMINUM CO	0	261,251	169,314	191,400	$0	$0	0.0%	0.0%
NORANDA ALUMINUM INC	0	322,810	209,209	236,500	$0	$0	0.0%	0.0%
COLUMBIA FALLS ALUMINUM CO	19,085	252,242	163,475	184,800	$8,218,361	$14,897,947	3.3%	5.9%
ALUMINUM COMPANY OF AMERICA /BADIN WORKS	0	172,666	111,903	126,500	$0	$0	0.0%	0.0%
ALUMINUM COMPANY OF AMERICA	0	187,680	121,633	137,500	$0	$0	0.0%	0.0%
REYNOLDS METALS CO ST LAWRENCE RED PLANT	0	184,677	119,687	135,300	$0	$0	0.0%	0.0%
ORMET PRIMARY ALUMINUM CORPORATION	0	384,369	249,105	281,600	$0	$0	0.0%	0.0%
NORTHWEST ALUMINUM COMPANY	12,306	123,118	79,791	90,200	$5,471,300	$9,778,482	4.4%	7.9%
ALUMAX OF SC	0	307,796	199,479	225,500	$0	$0	0.0%	0.0%
ALUMINUM COMPANY OF AMERICA-SOUTH PLANT	0	315,303	204,344	231,000	$0	$0	0.0%	0.0%
ALCOA Rockdale Works	0	472,954	306,516	346,500	$0	$0	0.0%	0.0%
KAISER ALUMINUM TACOMA WORKS	9,431	109,605	71,034	80,300	$2,889,536	$5,198,900	2.6%	4.7%
ALCOA WENATCHEE WORKS	0	330,317	214,075	242,000	$4,345,185	$7,646,337	1.3%	2.3%
INTALCO ALUMINUM CORP FERNDALE	36,343	408,392	264,674	299,200	$0	$0	0.0%	0.0%
KAISER ALUMINUM & CHEMICAL CORP	6,598	300,288	194,613	220,000	$17,000,452	$29,720,629	5.7%	9.9%
REYNOLDS METALS LONGVIEW	20,880	306,294	198,506	224,400	$9,527,539	$16,835,718	3.1%	5.5%
VANALCO INC	11,026	174,167	112,876	127,600	$4,988,758	$8,848,119	2.9%	5.1%
GOLDENDALE ALUMINUM CO	27,328	240,231	155,691	176,000	$12,128,260	$21,693,259	5.0%	9.0%
CENTURY ALUMINUM OF WV, INC.	0	252,242	163,475	184,800	$0	$0	0.0%	0.0%
Totals	**143,000**	**6,115,372**	**3,963,300**	**4,480,300**	**$64,569,392**	**$114,619,392**	**1.1%**	**1.9%**

* Waste in storage is estimated to range from 20,000 to 143,000 tons (the latter of which is shown here). The cost impact range is estimated based on 20,000 tons (Low Impact Estimate) and 143,000 tons (High Impact Estimate).

5.3 Regulatory Flexibility Screening Analysis

An overview summary of the impacts on the aluminum smelting industry, especially as related to Small Business Regulatory Flexibility Act requirements is presented in this section. Overall, the proposed revision in the K088 LDR treatment standard is not expected to have a significant impact on a substantial number of small entities. It is a Category 1 rule, and presumed **not** to have a significant impact on a substantial number of small entities, according to EPA guidelines. The Assistant Administrator may, at his or her discretion, still decide to require a full regulatory flexibility analysis for the rule.

The purpose of this screening analysis is to answer a series of questions regarding the potential impacts of the proposed K088 waste listing on small aluminum smelting entities. This analysis was conducted per the requirements of the Regulatory Flexibility Act (RFA) as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA). Some of the key questions to answer include:

1. Is the rule subject to SBREFA notice-and-comment rulemaking requirements?
2. What types of entities will be subject to the rule?
3. What types of small entities will be subject to the rule, if any?
4. Will small entities be adversely affected by the rule?
5. Will the rule have a significant economic impact on a substantial number of small entities?

In practice, questions 2-5 above are answered to the extent possible, the results of which are used to answer question one. More specifically, questions 2-5 will be used to identify what category of rule this may be in the SBREFA regulatory process. These consist of three categories starting with Category 1, which is defined as follows:[10]

Category 1: Rule presumed **not** to have a significant impact on a substantial number of small entities. (The Assistant Administrator may, at his or her discretion, still decide to require a full regulatory flexibility analysis for the rule.) Category 1 includes any of the following criteria:

A. Less than 1% impact on sales experienced by any number of affected small entities; or

B. A 1% or more impact on sales experienced by less than 100 small entities; or

C. A 1% or more impact on sales experienced by less than 20% of all affected small entities, and no more than 999 small entities affected.

Category 2: There is no presumption regarding whether the rule has a significant impact on a substantial number of small entities. If the program office believes the rule should be certified as

[10] U.S. EPA. 1999 (March 29). *Revised Interim Guidance for EPA Rulewriters: Regulatory Flexibility Act as Amended by the Small Business and Regulatory Enforcement Fairness Act.* Prepared by the Regulatory Management Division of EPA's Office of Policy.

not having a significant impact on a substantial number of small entities, it must so recommend through its steering committee representative to the Small Business Advocacy Chairperson (SBAC) and provide the SBAC with information and analysis supporting its recommendation. The SBAC will then determine whether he or she agrees with the program office's recommendation. Any disputes between the program office and the SBAC will be referred to the Deputy Administrator for resolution. Category 2 includes any of the following criteria:

A. A 1% or more impact on sales experienced by 100 to 999 small entities and these small entities represent 20% or more of the total number of small entities affected; or

B. A 1% or more impact on sales experienced by 1,000 or more small entities; or

C. A 3% or more impact on sales experienced by 100 to 999 small entities and these small entities represent 20% or more of the total number of small entities affected.

Category 3: The rule is presumed as being ineligible for certification that it does not have a significant impact on a substantial number of small entities. In this case an initial regulatory flexibility analysis or final regulatory flexibility analysis should generally be prepared.

A. A 3% or more impact on sales experienced by 100 to 999 small entities and these small entities represent 20% or more of the total number of small entities affected; or

B. A 3% or more impact on sales experienced by 1,000 or more small entities.

This screening analysis indicates that this rule is likely to be a *Category 1* rule with regard to SBREFA and RFA, falling under *Criteria B*, as described above. Accordingly the rule is not expected to have a significant impact on a substantial number of small entities.

Effects on Small Business

To best demonstrate the potential impact of proposed K088 regulations on small entities, the following section outlines the types of entities affected; presents a summary data for all K088 aluminum smelter generators; characterizes small entities according to size criteria set by the Small Business Administration (SBA); identifies the number of small entities potentially affected; and presents a range of economic effects and potential significant impacts for both small and large entities.

Type and Number of Entities Affected

The proposed listing will affect an estimated 16 aluminum smelting companies operating 22 facilities. While employment information has not been obtained for all of the companies in question, it has been determined that no more than nine of these companies are estimated to be small, according to the SBA definition for small (less than 1,000 employees).

Economic Effect on Small and Large Entities

The preliminary estimate of the impact on affected facilities indicates that compliance costs may exceed 1% of sales for as many as five small facilities. The overall impact to the entire affected population of facilities is expected to range from 0.0 to 1.8 percent of gross sales. The impacts estimated for the small companies are expected to range as high as 1.8 percent of sales for some facilities in the Northwest, under the assumption that the only K088 management facility would be the Reynolds facility in Arkansas.

Potential for Significant Impacts on Small Entities

Based on the findings above, it appears that the proposed waste listing will not have a significant impact on a substantial number of small facilities. The proposed listing is expected to impact no more than nine small companies.

5.4 Qualitative Economic Benefits

Economic benefits from the proposed rule are discussed qualitatively, based on each of the treatment technologies (Vortec and Goldendale). A brief discussion of human health benefits is presented in Chapter 6.

The benefits associated with the Vortec process include the recovery of valuable products, reductions in energy use and decreases in waste volumes, as summarized below.[11]

The Vortec vitrification process produces two usable products. The emissions recovered in the baghouse is primarily sodium fluoride, which is charged back into the aluminum reduction pots. The charging of the baghouse dust back into the pots aids in the support of the electrolyte, which is necessary for proper cell performance. The second product is a granular glass-like material, or frit that may be used to manufacture industrial-grade glass.

The Vortec process also may result in an energy savings over current management of K088. One estimate indicated a potential for over one trillion BTUs of energy savings in the U.S. aluminum and fiberglass manufacturing industries (based on 100,000 metric tons of SPL annually); 900 billion BTUs of natural gas are consumed annually for SPL treatment.[12]

Finally the Vortec process also may result in decreased volumes of waste. Under current treatment, a waste ash is generated. This ash is not generated with the Vortec process, resulting in a decrease demand for landfill space.

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[11] U.S. EPA, SITE Superfund Innovative Technology Evaluation: Emerging Technology Summary - Vitrification of Soils Contaminated by Hazardous and/or Radioactive Wastes, EPA/540/S-97/501, August 1997.

[12] U.S. DOE, Office of Industrial Technologies Energy Efficiency and Renewable Energy, Aluminum Fact Sheet: Technology for Converting Spent Potliner (SPL) to Useful Glass Fiber Products, January 1999. Http

The Goldendale process also results in recovery of valuable products, reductions in energy use and decreases in waste volumes.[13] This process produces a material which can be recycled into refractory brick which allows increased changeout of potliners and avoided energy losses associated with extended operation of the pots; by recycling this material waste volumes are reduced over current K088 waste management practices.

[13] EnviroSense, "NICE3: Recycling Spent Potliner from Aluminum Smelters," http://earth2.epa.gov/program/p2dept/energy/nice3/n3gr4.html

6.0 HUMAN HEALTH BENEFITS

Human health benefits from the proposed rule are discussed qualitatively in this chapter. The primary benefits are decreases in the potential releases of cyanide and fluoride and the associated reductions in human health effects from these exposures.

6.1 Benefits from Reduced Cyanide Exposure

K088 waste contains large amounts of acutely toxic cyanide. Concentrations of cyanide have been found in untreated potliners as high as 5,800 mg/kg, and in concentrations even higher in leachate from untreated spent potliners. Past land disposal of these wastes have resulted in cyanide groundwater contamination. Control of cyanide is the most important objective of the proposed treatment standards, given cyanide's toxicity, concentration in these wastes, and its potential to migrate from these wastes in high concentrations, as shown by the historic damage incidents.[14]

As noted above, EPA is proposing to revise certain treatment standards for K088 in order to reduce cyanide releases into the environment. The reduction in releases also may lead to reductions in human exposure and the detrimental human health effects known to be associated with such exposure. The current treatment standard for cyanide in K088 is a maximum of 590 mg/kg, of which no more than 30 mg/kg may be amenable cyanide. Under the proposed rule, the total cyanide would be reduced to no more than 1.4 mg/kg.

Cyanide is a general respiratory poison--although uptake can also occur through ingestion or dermal absorption--producing reactions within seconds, and death within minutes. Exposure to high levels of cyanide for a short period harms the central nervous system, respiratory system, and cardiovascular system. Short-term exposure to high levels of cyanide can cause coma and/or death.

Brief exposures to lower levels result in rapid, deep breathing; shortness of breath; convulsions; and loss of consciousness. Skin contact with dust from certain cyanide compounds can cause skin irritation and ulcerations. People have developed damage to the nervous system and thyroid gland after eating food containing low levels of cyanide for a long time. Effects on the nervous system believed to be from long-term exposure to cyanide include deafness, vision problems, and loss of muscle coordination. Effects on the thyroid gland can cause cretinism (retarded physical and mental growth in children), or enlargement and over activity of the gland. Exposure to lower levels may result in breathing difficulties, heart pains, vomiting, blood changes, headaches, and enlargement of the thyroid gland. Skin contact with cyanide can produce irritation and sores.[15]

While the proposed rule is expected to reduce the level of cyanide exposure, and avoid some of the health effects discussed above, a quantitative assessment of actual benefits is not possible at this time.

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[14] See, e.g., 63 FR at 51256; 51261.

[15] ATSDR. 1989. Public Health Statement: Cyanide

6.2 Benefits from Reduced Fluoride Exposure

K088 contains high levels of fluoride with concentrations greater than 10 percent; some data suggest that untreated potliner may have concentrations of fluoride greater than 20 percent. Predominantly, this fluoride is in the form of soluble sodium fluoride.[16] Unless immobilized or removed from the waste, this soluble fluoride has significant potential to contaminate surface water and groundwater and cause significant adverse effects to human health and the environment. Groundwater degradation, adverse ecological effects, and potential adverse human health effects may occur. Under the current K088 waste listing rule, treatment levels for fluoride are not specified.

Fluoride released to the air may be carried by wind and rain to nearby water, soil, and food sources. At low doses, fluoride is not harmful. In fact, toothpaste and mouth rinses have fluorides and many communities add fluorides to help prevent cavities. However, higher-level exposure can cause serious, long-term health problems. At high levels, fluorine gas and hydrogen fluoride gas can harm the lungs and heart and can cause death. Even at low levels, these gases can irritate your eyes, skin, and lungs. In children whose teeth are forming, high fluoride exposure can cause dental fluorosis with visible changes in the teeth. In adults, high fluoride over a long time can lead to skeletal fluorosis with denser bones, joint pain, and a limited joint movement.

As with cyanide, the proposed rule is expected to reduce the level of fluoride exposure and avoid some of the health effects discussed above. Again, a quantitative assessment of actual benefits is not possible at this time.

[16] See Background Document that can be found in EPA's docket supporting this rule.

APPENDIX A

Facility-Specific Baseline and Compliance Transportation, Permitting and Management Cost Estimates and Incremental Compliance Cost Estimates

Baseline Scenario - Transportation

EPA ID Number	**K088 (tons)**	Baseline Management Method	# Loads (20 tons/load)	Transportation Miles	Transportation Unit Cost ($/mile)	Transportation Costs
IND006366819	6,069	Reynolds	303	534	2.01	$325,222
KYD049062375	3,096	Reynolds	155	566	2.01	$176,337
KYD058692526	3,658	Reynolds	183	536	2.01	$197,157
MDD990759375	2,469	Reynolds	123	1079	1.91	$253,489
MOD093750966	5,643	Reynolds	282	306	2.31	$199,335
MTD057561763	4,558	Off-site Storage	228	473	2.01	$216,766
NCD003162542	1,142	Reynolds	57	862	1.91	$93,846
NYD002232304	2,043	Reynolds	102	1414	1.9	$274,033
NYD002245967	3,981	Reynolds	199	1414	1.9	$534,633
OHD004379970	5,170	Ormet - Vortec	259	0	0	$0
ORD981764707	2,939	Off-site Storage	147	57	2.41	$20,193
SCD097366165	2,449	Reynolds	122	952	1.91	$221,835
TND003383551	1,069	Reynolds	53	593	2.31	$72,601
TXD008091712	7,090	Reynolds	354	512	2.31	$418,683
WAD000065508	2,275	Off-site Storage	114	229	2.41	$62,915
WAD001882984	2,253	Off-site Storage	113	272	2.41	$74,074
WAD009270794	2,469	Reynolds	123	2291	1.9	$535,407
WAD009488131	8,681	Off-site Storage	434	350	2.41	$366,079
WAD057068561	4,987	Off-site Storage	249	180	2.41	$108,016
WAD981766751	2,634	Off-site Storage	132	153	2.41	$48,672
WAD990828642	6,527	Off-site Storage	326	48	2.41	$37,712
WVD009233297	6,546	Reynolds	327	843	1.98	$545,809
	87,746		4385			$4,782,815

Baseline Scenario - Management

EPA ID Number	K088 (tons)	Baseline Management Method	Low Estimate Management Unit Cost ($/ton)	Low Estimate Management Costs	High Estimate Management Unit Cost ($/ton)	High Estimate Management Costs
IND006366819	6,069	Reynolds	200	$1,213,800	500	$3,034,500
KYD049062375	3,096	Reynolds	200	$619,183	500	$1,547,958
KYD058692526	3,658	Reynolds	200	$731,600	500	$1,829,000
MDD990759375	2,469	Reynolds	200	$493,800	500	$1,234,500
MOD093750966	5,643	Reynolds	200	$1,128,500	500	$2,821,250
MTD057561763	4,558	Off-site Storage	245	$1,116,784	245	$1,116,784
NCD003162542	1,142	Reynolds	200	$228,312	500	$570,780
NYD002232304	2,043	Reynolds	200	$408,560	500	$1,021,400
NYD002245967	3,981	Reynolds	200	$796,200	500	$1,990,500
OHD004379970	5,170	Ormet - Vortec	0	$0	0	$0
ORD981764707	2,939	Off-site Storage	245	$720,133	245	$720,133
SCD097366165	2,449	Reynolds	200	$489,702	500	$1,224,255
TND003383551	1,069	Reynolds	200	$213,882	500	$534,705
TXD008091712	7,090	Reynolds	200	$1,417,956	500	$3,544,890
WAD000065508	2,275	Off-site Storage	245	$557,355	245	$557,355
WAD001882984	2,253	Off-site Storage	245	$551,931	245	$551,931
WAD009270794	2,469	Reynolds	200	$493,740	500	$1,234,350
WAD009488131	8,681	Off-site Storage	245	$2,126,731	245	$2,126,731
WAD057068561	4,987	Off-site Storage	245	$1,221,880	245	$1,221,880
WAD981766751	2,634	Off-site Storage	245	$645,260	245	$645,260
WAD990828642	6,527	Off-site Storage	245	$1,599,206	245	$1,599,206
WVD009233297	6,546	Reynolds	200	$1,309,200	500	$3,273,000
	87,746			$18,083,714		$32,400,366

COMPLIANCE - Scenario 1 - Transportation and Permitting

EPA ID Number	**K088 (tons)**	Transportation Miles	Transportation Unit Cost ($/mile)	Transportation Costs	Permitting
IND006366819	6,069	534	2.01	$325,222	$6,582
KYD049062375	3,096	566	2.01	$176,337	$3,358
KYD058692526	3,658	536	2.01	$197,157	$3,967
MDD990759375	2,469	1079	1.87	$248,181	$2,678
MOD093750966	5,643	306	2.31	$199,335	$6,120
MTD057561763	4,558	473	2.11	$227,551	$9,064
NCD003162542	1,142	862	1.89	$92,863	$1,238
NYD002232304	2,043	1414	1.87	$269,706	$2,216
NYD002245967	3,981	1414	1.87	$526,192	$4,318
OHD004379970	5,170	0	1.89	$0	$59,651
ORD981764707	2,939	57	3.41	$28,572	$5,844
SCD097366165	2,449	952	1.89	$219,512	$2,656
TND003383551	1,069	593	2.01	$63,172	$1,160
TXD008091712	7,090	512	2.01	$364,308	$7,689
WAD000065508	2,275	229	2.41	$62,915	$4,523
WAD001882984	2,253	272	2.41	$74,074	$4,479
WAD009270794	2,469	227	2.41	$67,290	$4,909
WAD009488131	8,681	350	2.31	$350,889	$17,260
WAD057068561	4,987	180	3.41	$152,836	$9,916
WAD981766751	2,634	153	3.41	$68,868	$5,237
WAD990828642	6,527	48	3.41	$53,360	$12,979
WVD009233297	6,546	843	1.89	$520,999	$7,100
	87,746			$4,289,340	$182,942

COMPLIANCE - Scenario 1 - Management						INCREMENTAL - Scenario 1	
EPA ID Number	**K088 (tons)**	Low Estimate Management Unit Cost ($/ton)	Low Estimate Management Costs	High Estimate Management Unit Cost ($/ton)	High Estimate Management Costs	Low Estimate	High Estimate
IND006366819	6,069	399.28	$2,423,233	749.28	$4,547,383	$1,216,015	$1,519,465
KYD049062375	3,096	399.28	$1,236,138	749.28	$2,319,708	$620,313	$775,109
KYD058692526	3,658	399.28	$1,460,568	749.28	$2,740,868	$732,935	$915,835
MDD990759375	2,469	399.28	$985,823	749.28	$1,849,973	$489,392	$612,842
MOD093750966	5,643	399.28	$2,252,939		$4,227,814	$1,130,559	$1,412,684
MTD057561763	4,558	412.69	$1,881,169	762.69	$3,476,574	$784,234	$2,379,639
NCD003162542	1,142	399.28	$455,802	749.28	$855,348	$227,746	$284,824
NYD002232304	2,043	399.28	$815,650	749.28	$1,530,630	$404,979	$507,119
NYD002245967	3,981	399.28	$1,589,535	749.28	$2,982,885	$789,211	$988,261
OHD004379970	5,170	$0	$0	$0	$0	$59,651	$59,651
ORD981764707	2,939	412.69	$1,213,030	762.69	$2,241,791	$507,121	$1,535,882
SCD097366165	2,449	399.28	$977,642	749.28	$1,834,620	$488,273	$610,698
TND003383551	1,069	399.28	$426,994	749.28	$801,288	$204,844	$258,314
TXD008091712	7,090	399.28	$2,830,810	749.28	$5,312,233	$1,366,169	$1,720,658
WAD000065508	2,275	412.69	$938,838	762.69	$1,735,059	$386,007	$1,182,227
WAD001882984	2,253	412.69	$929,702	762.69	$1,718,175	$382,250	$1,170,723
WAD009270794	2,469	412.69	$1,018,810	762.69	$1,882,855	$61,862	$185,297
WAD009488131	8,681	412.69	$3,582,379	762.69	$6,620,566	$1,457,718	$4,495,905
WAD057068561	4,987	412.69	$2,058,200	762.69	$3,803,743	$891,056	$2,636,599
WAD981766751	2,634	412.69	$1,086,911	762.69	$2,008,711	$467,083	$1,388,883
WAD990828642	6,527	412.69	$2,693,787	762.69	$4,978,366	$1,123,208	$3,407,788
WVD009233297	6,546	399.28	$2,613,689	749.28	$4,904,789	$1,286,779	$1,614,079
	87,746		$33,471,650		$62,373,381	$15,077,403	$29,662,482

COMPLIANCE - Scenario 2 - Transportation and Permitting

EPA ID Number	**K088** **(tons)**	Transportation Miles	Transportation Unit Cost ($/mile)	Transportation Costs	Permitting
IND006366819	6,069	534	2.01	$325,222	$4,259
KYD049062375	3,096	566	2.01	$176,337	$2,173
KYD058692526	3,658	536	2.01	$197,157	$2,567
MDD990759375	2,469	1079	1.87	$248,181	$1,733
MOD093750966	5,643	306	2.31	$199,335	$3,960
MTD057561763	4,558	2047	1.87	$872,759	$3,199
NCD003162542	1,142	862	1.89	$92,863	$801
NYD002232304	2,043	1414	1.87	$269,706	$1,434
NYD002245967	3,981	1414	1.87	$526,192	$2,794
OHD004379970	5,170	0	1.89	$0	$59,651
ORD981764707	2,939	2197	1.87	$603,933	$2,063
SCD097366165	2,449	952	1.89	$219,512	$1,718
TND003383551	1,069	593	2.01	$63,172	$750
TXD008091712	7,090	512	2.01	$364,308	$4,975
WAD000065508	2,275	2124	1.87	$452,794	$1,596
WAD001882984	2,253	2366	1.87	$499,959	$1,581
WAD009270794	2,469	2291	1.87	$526,953	$1,732
WAD009488131	8,681	2444	1.87	$1,983,502	$6,092
WAD057068561	4,987	2321	1.87	$1,080,727	$3,500
WAD981766751	2,634	2281	1.87	$563,042	$1,848
WAD990828642	6,527	2188	1.87	$1,333,849	$4,581
WVD009233297	6,546	843	1.89	$520,999	$4,594
	87,746			$11,120,503	$117,601

COMPLIANCE - Scenario 2 - Management

EPA ID Number	K088 (tons)	Low Estimate Management Unit Cost ($/ton)	Low Estimate Management Costs	High Estimate Management Unit Cost ($/ton)	High Estimate Management Costs	INCREMENTAL - Scenario 2 Low Estimate	INCREMENTAL - Scenario 2 High Estimate
IND006366819	6,069	456.97	$2,773,342	806.97	$4,897,492	$1,563,801	$1,867,251
KYD049062375	3,096	456.97	$1,414,736	806.97	$2,498,306	$797,725	$952,521
KYD058692526	3,658	456.97	$1,671,591	806.97	$2,951,891	$942,558	$1,125,458
MDD990759375	2,469	456.97	$1,128,255	806.97	$1,992,405	$630,879	$754,329
MOD093750966	5,643	456.97	$2,578,445	806.97	$4,553,320	$1,453,905	$1,736,030
MTD057561763	4,558	456.97	$2,083,000	806.97	$3,678,405	$1,625,408	$3,220,813
NCD003162542	1,142	456.97	$521,657	806.97	$921,202	$293,163	$350,241
NYD002232304	2,043	456.97	$933,495	806.97	$1,648,475	$522,042	$624,182
NYD002245967	3,981	456.97	$1,819,192	806.97	$3,212,542	$1,017,344	$1,216,394
OHD004379970	5,170	0.00	$0	$0	$0	$59,651	$59,651
ORD981764707	2,939	456.97	$1,343,176	806.97	$2,371,937	$1,208,846	$2,237,607
SCD097366165	2,449	456.97	$1,118,892	806.97	$1,975,871	$628,586	$751,011
TND003383551	1,069	456.97	$488,687	806.97	$862,980	$266,127	$319,597
TXD008091712	7,090	456.97	$3,239,807	806.97	$5,721,230	$1,772,452	$2,126,941
WAD000065508	2,275	456.97	$1,039,566	806.97	$1,835,786	$873,686	$1,669,907
WAD001882984	2,253	456.97	$1,029,450	806.97	$1,817,923	$904,985	$1,693,458
WAD009270794	2,469	456.97	$1,128,118	806.97	$1,992,163	$627,657	$751,092
WAD009488131	8,681	456.97	$3,966,732	806.97	$7,004,919	$3,463,515	$6,501,702
WAD057068561	4,987	456.97	$2,279,024	806.97	$4,024,567	$2,033,355	$3,778,898
WAD981766751	2,634	456.97	$1,203,525	806.97	$2,125,325	$1,074,483	$1,996,283
WAD990828642	6,527	456.97	$2,982,803	806.97	$5,267,382	$2,684,315	$4,968,894
WVD009233297	6,546	456.97	$2,991,316	806.97	$5,282,416	$1,661,901	$1,989,201
	87,746		$37,734,807		$66,636,539	$26,106,382	$40,691,461

COMPLIANCE - Scenario 3 - Transportation and Permitting

EPA ID Number	K088 (tons)	Transportation Miles	Transportation Unit Cost ($/mile)	Transportation Costs	Permitting
IND006366819	6,069	534	2.01	$325,222	$6,582
KYD049062375	3,096	566	2.01	$176,337	$3,358
KYD058692526	3,658	536	2.01	$197,157	$3,967
MDD990759375	2,469	1079	1.87	$248,181	$2,678
MOD093750966	5,643	306	2.31	$199,335	$6,120
MTD057561763	4,558	2047	1.87	$872,759	$59,651
NCD003162542	1,142	862	1.89	$92,863	$1,238
NYD002232304	2,043	1414	1.87	$269,706	$2,216
NYD002245967	3,981	1414	1.87	$526,192	$4,318
OHD004379970	5,170	0	1.89	$0	$59,651
ORD981764707	2,939	2197	1.87	$603,933	$59,651
SCD097366165	2,449	952	1.89	$219,512	$2,656
TND003383551	1,069	593	2.01	$63,172	$1,160
TXD008091712	7,090	512	2.01	$364,308	$7,689
WAD000065508	2,275	2124	1.87	$452,794	$59,651
WAD001882984	2,253	2366	1.87	$499,959	$59,651
WAD009270794	2,469	2291	1.87	$526,953	$59,651
WAD009488131	8,681	2444	1.87	$1,983,502	$59,651
WAD057068561	4,987	2321	1.87	$1,080,727	$59,651
WAD981766751	2,634	2281	1.87	$563,042	$59,651
WAD990828642	6,527	2188	1.87	$1,333,849	$59,651
WVD009233297	6,546	843	1.89	$520,999	$7,100
	87,746			$11,120,503	$645,588

COMPLIANCE - Scenario 3 - Management								INCREMENTAL - Scenario 3	
EPA ID Number	**K088 (tons)**	Low Estimate Management Unit Cost ($/ton)	Low Estimate Management Costs	High Estimate Management Unit Cost ($/ton)	High Estimate Management Costs	On-site Mgmt. Unit Cost ($/ton) (Incl. 40% xs capacity in capital cost)	On-Site Mgmt. Costs	Low Estimate	High Estimate
IND006366819	6,069	399.28	$2,423,233	749.28	$4,547,383	$999,999	$0	$1,216,015	$1,519,465
KYD049062375	3,096	399.28	$1,236,138	749.28	$2,319,708	$999,999	$0	$620,313	$775,109
KYD058692526	3,658	399.28	$1,460,568	749.28	$2,740,868	$999,999	$0	$732,935	$915,835
MDD990759375	2,469	399.28	$985,823	749.28	$1,849,973	$999,999	$0	$489,392	$612,842
MOD093750966	5,643	399.28	$2,252,939	749.28	$4,227,814	$999,999	$0	$1,130,559	$1,412,684
MTD057561763	4,558	399.28	$1,820,040	749.28	$3,415,445	$471	$2,147,442	$873,543	$873,543
NCD003162542	1,142	399.28	$455,802	749.28	$855,348	$999,999	$0	$227,746	$284,824
NYD002232304	2,043	399.28	$815,650	749.28	$1,530,630	$999,999	$0	$404,979	$507,119
NYD002245967	3,981	399.28	$1,589,535	749.28	$2,982,885	$999,999	$0	$789,211	$988,261
OHD004379970	5,170	$0	$0	$0	$0	$0	$0	$59,651	$59,651
ORD981764707	2,939	399.28	$1,173,612	749.28	$2,202,373	$482	$1,417,314	$736,638	$736,638
SCD097366165	2,449	399.28	$977,642	749.28	$1,834,620	$999,999	$0	$488,273	$610,698
TND003383551	1,069	399.28	$426,994	749.28	$801,288	$999,999	$0	$204,844	$258,314
TXD008091712	7,090	399.28	$2,830,810	749.28	$5,312,233	$999,999	$0	$1,366,169	$1,720,658
WAD000065508	2,275	399.28	$908,330	749.28	$1,704,551	$500	$1,137,902	$577,283	$577,283
WAD001882984	2,253	399.28	$899,491	749.28	$1,687,964	$501	$1,128,733	$562,379	$562,379
WAD009270794	2,469	399.28	$985,703	749.28	$1,849,748	$494	$1,218,498	$249,002	$0
WAD009488131	8,681	399.28	$3,465,967	749.28	$6,504,154	$510	$4,423,601	$1,990,442	$1,990,442
WAD057068561	4,987	399.28	$1,991,317	749.28	$3,736,861	$472	$2,355,068	$1,084,822	$1,084,822
WAD981766751	2,634	399.28	$1,051,591	749.28	$1,973,391	$489	$1,287,669	$653,387	$653,387
WAD990828642	6,527	399.28	$2,606,251	749.28	$4,890,830	$483	$3,154,948	$1,577,682	$1,577,682
WVD009233297	6,546	399.28	$2,613,689	749.28	$4,904,789	$999,999	$0	$1,286,779	$1,614,079
	87,746		$32,971,125		$61,872,857		$18,271,175	$17,322,043	$19,335,714

Baseline Costs (Stored Waste) - Transportation and Management – 143,000 ton example

EPA ID Number	K088 (tons)	Baseline Management Method	# Loads (20 tons/load)	Transportation Costs	Low Estimate Management Unit Cost ($/ton)	Low Estimate Management Costs	High Estimate Management Unit Cost ($/ton)	High Estimate Management Costs
IND006366819	0	Reynolds	0	$0	0	$0	0	$0
KYD049062375	0	Reynolds	0	$0	0	$0	0	$0
KYD058692526	0	Reynolds	0	$0	0	$0	0	$0
MDD990759375	0	Reynolds	0	$0	0	$0	0	$0
MOD093750966	0	Reynolds	0	$0	0	$0	0	$0
MTD057561763	19,085	Off-site Storage	954	$0	160	$3,053,525	160	$3,053,525
NCD003162542	0	Reynolds	0	$0	0	$0	0	$0
NYD002232304	0	Reynolds	0	$0	0	$0	0	$0
NYD002245967	0	Reynolds	0	$0	0	$0	0	$0
OHD004379970	0	Ormet - Vortec	0	$0	0	$0	0	$0
ORD981764707	12,306	Off-site Storage	615	$0	160	$1,968,998	160	$1,968,998
SCD097366165	0	Reynolds	0	$0	0	$0	0	$0
TND003383551	0	Reynolds	0	$0	0	$0	0	$0
TXD008091712	0	Reynolds	0	$0	0	$0	0	$0
WAD000065508	6,598	Off-site Storage	330	$0	160	$1,055,709	160	$1,055,709
WAD001882984	9,432	Off-site Storage	472	$0	160	$1,509,098	160	$1,509,098
WAD009270794	0	Reynolds	0	$0	0	$0	0	$0
WAD009488131	36,343	Off-site Storage	1817	$0	160	$5,814,938	160	$5,814,938
WAD057068561	20,881	Off-site Storage	1044	$0	160	$3,340,882	160	$3,340,882
WAD981766751	11,027	Off-site Storage	551	$0	160	$1,764,279	160	$1,764,279
WAD990828642	27,329	Off-site Storage	1366	$0	160	$4,372,571	160	$4,372,571
WVD009233297	0	Reynolds	0	$0	0	$0	0	$0
	143,000		7149	$0		$22,880,000		$22,880,000

COMPLIANCE (Stored Wastes) - Scenario 1 - Transportation and Management – 143,000 ton example								INCREMENTAL - Scenario 1	
EPA ID Number	**K088 (tons)**	Transportation Miles	Transportation Unit Cost ($/mile)	Low Estimate Management Unit Cost ($/ton)	Low Estimate Management Costs	High Estimate Management Unit Cost ($/ton)	High Estimate Management Costs	Low Estimate	High Estimate
IND006366819	0	0	2.01	0.00	$0	749.28	$0	$0	$0
KYD049062375	0	0	2.01	0.00	$0	0.00	$0	$0	$0
KYD058692526	0	0	2.01	0.00	$0	0.00	$0	$0	$0
MDD990759375	0	0	1.91	0.00	$0	0.00	$0	$0	$0
MOD093750966	0	0	2.31	0.00	$0	0.00	$0	$0	$0
MTD057561763	19,085	0	2.01	412.69	$7,876,015	762.69	$14,555,602	$4,822,490	$11,502,076
NCD003162542	0	0	1.91	0.00	$0	0.00	$0	$0	$0
NYD002232304	0	0	1.9	0.00	$0	0.00	$0	$0	$0
NYD002245967	0	0	1.9	0.00	$0	0.00	$0	$0	$0
OHD004379970	0	0	1.98	0.00	$0	0.00	$0	$0	$0
ORD981764707	12,306	0	2.41	412.69	$5,078,673	762.69	$9,385,855	$3,109,675	$7,416,857
SCD097366165	0	0	1.91	0.00	$0	0.00	$0	$0	$0
TND003383551	0	0	2.31	0.00	$0	0.00	$0	$0	$0
TXD008091712	0	0	2.31	0.00	$0	0.00	$0	$0	$0
WAD000065508	6,598	0	2.41	412.69	$2,723,011	762.69	$5,032,375	$1,667,302	$3,976,666
WAD001882984	9,432	0	2.41	412.69	$3,892,444	762.69	$7,193,596	$2,383,347	$5,684,498
WAD009270794	0	0	1.9	412.69	$0	762.69	$0	$0	$0
WAD009488131	36,343	0	2.41	412.69	$14,998,580	762.69	$27,718,757	$9,183,642	$21,903,819
WAD057068561	20,881	0	2.41	412.69	$8,617,200	762.69	$15,925,379	$5,276,318	$12,584,497
WAD981766751	11,027	0	2.41	412.69	$4,550,639	762.69	$8,410,001	$2,786,360	$6,645,721
WAD990828642	27,329	0	2.41	412.69	$11,278,254	762.69	$20,843,252	$6,905,683	$16,470,682
WVD009233297	0	0	1.98	0.00	$0	0.00	$0	$0	$0
	143,000				$59,014,816		$109,064,816	$36,134,816	$86,184,816

COMPLIANCE (Stored Wastes) - Scenario 2 - Transportation – 143,000 ton example

EPA ID Number	**K088 (tons)**	Transportation Miles	Transportation Unit Cost ($/mile)	Transportation Costs
IND006366819	0	0	2.01	$0
KYD049062375	0	0	2.01	$0
KYD058692526	0	0	2.01	$0
MDD990759375	0	0	1.91	$0
MOD093750966	0	0	2.31	$0
MTD057561763	19,085	2000	1.87	$3,567,960
NCD003162542	0	0	1.91	$0
NYD002232304	0	0	1.9	$0
NYD002245967	0	0	1.9	$0
OHD004379970	0	0	1.98	$0
ORD981764707	12,306	2000	1.87	$2,300,100
SCD097366165	0	0	1.91	$0
TND003383551	0	0	2.31	$0
TXD008091712	0	0	2.31	$0
WAD000065508	6,598	2000	1.87	$1,234,200
WAD001882984	9,432	2000	1.87	$1,765,280
WAD009270794	0	0	1.9	$0
WAD009488131	36,343	2000	1.87	$6,795,580
WAD057068561	20,881	2000	1.87	$3,904,560
WAD981766751	11,027	2000	1.87	$2,060,740
WAD990828642	27,329	2000	1.87	$5,108,840
WVD009233297	0	0	1.98	$0
	143,000			$26,737,260

COMPLIANCE (Stored Wastes) - Scenario 2 -Management – 143,000 ton example						INCREMENTAL - Scenario 2	
EPA ID Number	**K088 (tons)**	Low Estimate Management Unit Cost ($/ton)	Low Estimate Management Costs	High Estimate Management Unit Cost ($/ton)	High Estimate Management Costs	Low Estimate	High Estimate
IND006366819	0	0.00	$0	806.97	$0	$0	$0
KYD049062375	0	0.00	$0	0.00	$0	$0	$0
KYD058692526	0	0.00	$0	0.00	$0	$0	$0
MDD990759375	0	0.00	$0	0.00	$0	$0	$0
MOD093750966	0	0.00	$0	0.00	$0	$0	$0
MTD057561763	19,085	456.97	$8,721,031	806.97	$15,400,618	$9,235,466	$15,915,052
NCD003162542	0	0.00	$0	0.00	$0	$0	$0
NYD002232304	0	0.00	$0	0.00	$0	$0	$0
NYD002245967	0	0.00	$0	0.00	$0	$0	$0
OHD004379970	0	0.00	$0	0.00	$0	$0	$0
ORD981764707	12,306	456.97	$5,623,562	806.97	$9,930,745	$5,954,665	$10,261,847
SCD097366165	0	0.00	$0	0.00	$0	$0	$0
TND003383551	0	0.00	$0	0.00	$0	$0	$0
TXD008091712	0	0.00	$0	0.00	$0	$0	$0
WAD000065508	6,598	456.97	$3,015,162	806.97	$5,324,526	$3,193,653	$5,503,017
WAD001882984	9,432	456.97	$4,310,064	806.97	$7,611,215	$4,566,246	$7,867,398
WAD009270794	0	456.97	$0	806.97	$0	$0	$0
WAD009488131	36,343	456.97	$16,607,774	806.97	$29,327,951	$17,588,416	$30,308,593
WAD057068561	20,881	456.97	$9,541,738	806.97	$16,849,917	$10,105,416	$17,413,595
WAD981766751	11,027	456.97	$5,038,877	806.97	$8,898,238	$5,335,337	$9,194,698
WAD990828642	27,329	456.97	$12,488,296	806.97	$22,053,294	$13,224,565	$22,789,563
WVD009233297	0	0.00	$0	0.00	$0	$0	$0
	143,000		$65,346,504		$115,396,504	$69,203,764	$119,253,764

COMPLIANCE (Stored Wastes) - Scenario 3 - Transportation – 143,000 ton example

EPA ID Number	**K088 (tons)**	Transportation Miles	Transportation Unit Cost ($/mile)	Transportation Costs
IND006366819	0	0	2.01	$0
KYD049062375	0	0	2.01	$0
KYD058692526	0	0	2.01	$0
MDD990759375	0	0	1.87	$0
MOD093750966	0	0	2.31	$0
MTD057561763	19,085	2047	1.87	$3,651,807
NCD003162542	0	0	1.89	$0
NYD002232304	0	0	1.87	$0
NYD002245967	0	0	1.87	$0
OHD004379970	0	0	1.89	$0
ORD981764707	12,306	2197	1.87	$2,526,660
SCD097366165	0	0	1.89	$0
TND003383551	0	0	2.01	$0
TXD008091712	0	0	2.01	$0
WAD000065508	6,598	2124	1.87	$1,310,720
WAD001882984	9,432	2366	1.87	$2,088,326
WAD009270794	0	0	1.87	$0
WAD009488131	36,343	2444	1.87	$8,304,199
WAD057068561	20,881	2321	1.87	$4,531,242
WAD981766751	11,027	2281	1.87	$2,350,274
WAD990828642	27,329	2188	1.87	$5,589,071
WVD009233297	0	0	1.89	$0
	143,000			$30,352,299

COMPLIANCE (Stored Wastes) - Scenario 3 - Management – 143,000 ton example						INCREMENTAL - Scenario 3	
EPA ID Number	**K088 (tons)**	Low Estimate Management Unit Cost ($/ton)	Low Estimate Management Costs	High Estimate Management Unit Cost ($/ton)	High Estimate Management Costs	Low Estimate	High Estimate
IND006366819	0	0.00	$0	0.00	$0	$0	$0
KYD049062375	0	0.00	$0	0.00	$0	$0	$0
KYD058692526	0	0.00	$0	0.00	$0	$0	$0
MDD990759375	0	0.00	$0	0.00	$0	$0	$0
MOD093750966	0	0.00	$0	0.00	$0	$0	$0
MTD057561763	19,085	399.28	$7,620,079	749.28	$14,299,665	$8,218,361	$14,897,947
NCD003162542	0	0.00	$0	0.00	$0	$0	$0
NYD002232304	0	0.00	$0	0.00	$0	$0	$0
NYD002245967	0	0.00	$0	0.00	$0	$0	$0
OHD004379970	0	0.00	$0	0.00	$0	$0	$0
ORD981764707	12,306	399.28	$4,913,638	749.28	$9,220,820	$5,471,300	$9,778,482
SCD097366165	0	0.00	$0	0.00	$0	$0	$0
TND003383551	0	0.00	$0	0.00	$0	$0	$0
TXD008091712	0	0.00	$0	0.00	$0	$0	$0
WAD000065508	6,598	399.28	$2,634,525	749.28	$4,943,889	$2,889,536	$5,198,900
WAD001882984	9,432	399.28	$3,765,957	749.28	$7,067,108	$4,345,185	$7,646,337
WAD009270794	0	399.28	$0	749.28	$0	$0	$0
WAD009488131	36,343	399.28	$14,511,191	749.28	$27,231,368	$17,000,452	$29,720,629
WAD057068561	20,881	399.28	$8,337,179	749.28	$15,645,358	$9,527,539	$16,835,718
WAD981766751	11,027	399.28	$4,402,763	749.28	$8,262,125	$4,988,758	$8,848,119
WAD990828642	27,329	399.28	$10,911,760	749.28	$20,476,758	$12,128,260	$21,693,259
WVD009233297	0	0.00	$0	0.00	$0	$0	$0
	143,000		$57,097,093		$107,147,093	$64,569,392	$114,619,392